

# **Safeguarding Machinery and Equipment**

## ***General Requirements***

**Some Common  
Safeguarding Applications:  
Woodworking equipment**



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Equipment and machinery used in woodworking are dangerous when used improperly or without proper safeguards. The most common injuries to workers are lacerations, amputations of the fingers and hands, and loss of sight. Besides traumatic injuries, workers in this industry can suffer from skin and respiratory diseases from exposure to wood dust and the chemicals used in finishing.

This section describes the principal hazards of woodworking equipment and some methods for controlling these hazards through safeguarding. *It is not a substitute for a thorough knowledge of the Occupational Health and Safety Regulation.* This section does not cover machinery used in the primary production of lumber and basic wood materials at sawmills and lumber remanufacturing plants.

### **Safety and health hazards**

The main occupational hazards associated with woodworking operations are as follows.

#### **Safety hazards**

- Machine hazards (point of operation, power transmission components)
- Kickbacks
- Flying chips and material
- Tool projectiles (unbalanced cutter heads)
- Fire and explosion
- Electrical

#### **Health hazards**

- Chemical (sensitization from exposure to finishes, coatings, adhesives, solvents)
- Wood dust (some are carcinogens)
- Noise
- Vibration

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### *Point-of-operation hazards*

The point of operation of a woodworking machine is where the stock is cut, shaped, bored, or formed. Most woodworking machines use a cutting and/or shearing action. Here are some examples of how injuries can occur at the point of operation:

- **Hands too close** to the blade, particularly when working on small pieces of stock. Accidents occur when stock unexpectedly moves or when a worker's hand slips.
- The work piece is **not properly supported**, a common unsafe work practice with table saws. The worker assumes an awkward handling position, often with hands over or behind the blade. Loss of control or balance causes hands to contact the blade.
- Stock gets **stuck** in a blade and actually pulls the operator's hands into the machine.
- **Machine safeguard is not properly adjusted and maintained.** For example, a radial arm saw blade which can overhang the cutting table may snag clothing and pull the worker into the running blade.
- Machine controls are not properly positioned or protected from **inadvertent activation.**
- A worker reaches in to clean a saw or remove a piece of wood after the saw has been turned off but while it is still **coasting** or **idling.** (Saw blades often move so fast that it can be difficult to see if they are actually moving, especially under fluorescent lighting.)
- Contact can occur during repair and maintenance if the machine starts unexpectedly because **lockout** procedures were not followed.

To view relevant WorkSafeBC Hazard Alerts, go to WorkSafeBC.com, click "Find a hazard alert poster" under Safety at Work, then click "Guarding" under Topic.

### *Kickbacks*

Kickbacks occur when a saw seizes the stock and hurls it back at the operator. This can happen when the stock twists and binds against the side of the blade or is caught in the teeth – often caused by a dull blade or one that is set at an incorrect height. Poor-quality lumber (splits, frozen, many knots, foreign objects) will increase the likelihood of kickback.

Kickback hazards are most likely when there is a lack of safeguards such as spreaders, anti-kickback fingers, and gauge or rip fences. Kickbacks occur more often when **ripping** (cutting parallel to the grain) than when crosscutting.

### *Tool projectiles*

Many pieces of woodworking equipment – such as routers, shapers, and moulders – use rotating cutter heads with multiple knives. Cutter heads that are not properly adjusted, or that are poorly mounted or have broken

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knives, can become unbalanced. Balance is critical for keeping knives secured to a rapidly moving cutter head. The centrifugal forces on an unbalanced cutter head can fling the knives from the tool and severely or fatally injure the operator or other persons nearby.

Using the wrong tool on a cutter head or using a tool at a higher speed than it was designed for can cause the tool to break and create a deadly projectile.

### **Preventive measures**

The following is a summary of preventive measures to control workplace hazards in woodworking shops. Please refer also to the “Hierarchy of safeguarding controls” on page 18 of *Safeguarding Machinery and Equipment*.

#### ***Engineering controls (guards)***

These involve physically changing the machine or work environment to prevent employee exposure to the potential hazard. Examples include fitting the machine with a guard, or using local exhaust ventilation to remove dust and other contaminants at the source. Engineering controls must always be the first consideration.

Safeguarding the point of operation of hand-fed woodworking machinery presents a challenge: how do you build a guard to allow the stock into the blade or cutter while at the same time keeping fingers out? *The best working compromise is a self-closing guard that effectively prevents the operator from contacting the unused portion of the blade or cutting tool.* Investigation determines time and again that in most incidents, the worker contacted the cutting tool in a manner inconsistent with normal feeding practice.

#### ***Administrative controls (safe work practice)***

These involve removing workers from the hazard by changing the way they do their job. For example, push sticks and push blocks could be used to guide short or narrow pieces of work through saws and cutting tools. Lockout procedures are another example of an administrative control. Administrative controls always involve training and supervision.

#### ***Personal protective equipment***

Personal protective equipment encompasses a wide variety of devices and garments designed to protect a worker from injury or disease. Examples include respirators, safety eyewear, face shields, safety footwear, gloves, and hearing protection. Workers must **avoid loose clothing or long, unconfined hair**, which can become snagged in moving machine parts.

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## Safeguarding commonly used on woodworking machines

The following are recommended point-of-operation safeguarding techniques and safe work practices for several machines commonly used in the woodworking industry. Personal protective equipment is not specifically covered because its use applies to all industrial machinery. Work practices that apply to all woodworking equipment (such as using a brush for cleaning saws) are not covered either.

### Table saw

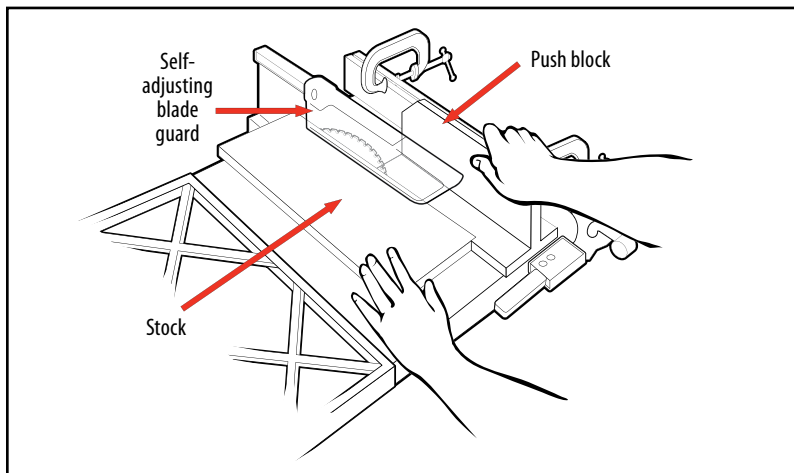


Figure 4.12. Typical table saw.

#### Use and operation

Table saws are used for straight sawing. Depending on the blade, they cut either across (crosscut) or with (ripsaw) the grain of the wood. With hand-fed saws, the operator adjusts the height and angle of the blade, then, holding the stock, pushes the stock into the blade. A guide or fence is used to maintain a straight cut at the desired width. Power-feed or power table saws are equipped with feed rollers or a conveyor system to hold the lumber and force-feed it into the saw blade.

#### How injuries occur

An operator's hands can slip while feeding the stock into the saw, or if the hands are too close to the blade. Workers can also be injured when removing scrap or finished pieces from the table.

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Kickbacks are another major cause of injury. They are more likely to occur when ripping rather than crosscutting. Kickbacks can occur if:

- Safeguards are not used.
- Poor-quality lumber is cut.
- The blade height is not correct.
- The blade is not properly maintained.

Other sources of injury are unguarded power transmission parts (belts and pulleys) and nip points of automatic feeders. Clothing, hair, or hands may be caught by and pulled into the in-running feed rolls.

**Recommended engineering controls**

- **Ripping and crosscutting** – Enclose the portion of the saw above the table with a self-adjusting guard as shown in Figure 4.12. The guard must adjust to the thickness of the material being cut and remain in contact with it. The guard should be hinged so it can be easily moved away for saw changes.
- **Ripsaws** – Use a spreader to prevent material from squeezing the saw or kicking back during ripping. Use anti-kickback fingers to hold the stock down in case the saw kicks back the material.
- Guard all drive belts and in-running nip points.
- Always ensure that the portion of the blade below the table is guarded from unintended contact.

**Recommended safe work practices**

- Keep hands out of the line of cut.
- Use the proper blade for the cutting action (for example, don't use a crosscut blade for ripping).
- Maintain a sharp blade in good condition.
- Stand to one side of the saw blade to avoid injury from possible kickback.
- Use a push stick for small pieces of wood and for pushing stock past the blade.
- Use jigs to support pieces of stock to avoid having to put excessive hand pressure on the work piece.
- Do not attempt to crosscut long boards on a table saw.

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## Radial arm saw

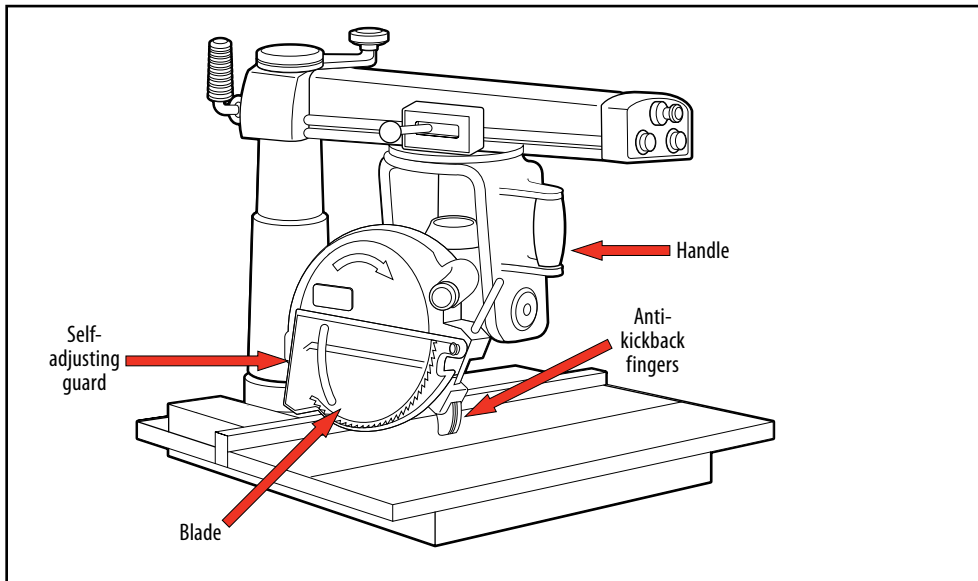


Figure 4.13. Typical radial arm saw.

### Use and operation

Radial arm saws are circular saws that rotate downward either with (rip) or against (crosscut) the wood grain. For crosscutting, the wood is placed against a fence away from the operator and the blade is pulled into the stock. For rip cuts, the blade is set parallel to the fence and the stock is pushed through.

Radial arm saws have features that make them more versatile than table saws. The saw arm can be raised and lowered and swung to the side to adjust the depth and horizontal angle of the cut. The blade can be replaced with shaping cutters, disk or drum sanders, or other accessories.

Radial arm saws are the preferred choice for cut-to-length operations when other saws are not available.

### How injuries occur

The principal types of injury from radial arm saws are cuts to the arms and hands, or amputation of fingers from contact with the blade or from flying wood chips. Kickback can also occur; workers nearby can be seriously injured if stock that is fed in the wrong direction (especially when ripping) is flung out of the saw.

Injuries can also occur when the leading edge of the blade extends beyond the front of the cutting table; an operator's clothing or body can be snagged by the saw blade.

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### Recommended engineering controls

- Enclose the upper half of the saw (from the blade down to the end of the saw arbor) with a fixed hood. Guard the lower half with a self-adjusting, floating guard that rises and falls with the stock.
- Make sure the saw has a return device. The front end of the unit should be slightly higher than the rear so that the cutting head will return to its original position when released by the operator. This will also prevent the cutting head from rolling or travelling due to gravity or vibration.
- Set the end travel stop to prevent the forward travel of the blade from overhanging the cutting table.

### Recommended safe work practices

- During crosscutting, operate the saw on the side of the table with the handle.
- During ripping, make sure the stock is fed in the correct direction to avoid serious kickback hazard.
- Clearly mark the direction of saw rotation on the protective hood (guard).
- Measure boards using an end stop gauge. If measuring by rule, turn off the saw.
- Wait for the blade to stop before making measurements.
- Before performing angular cuts, check the intended direction of the saw blade (for example, compound 45° cuts).

### Band saw

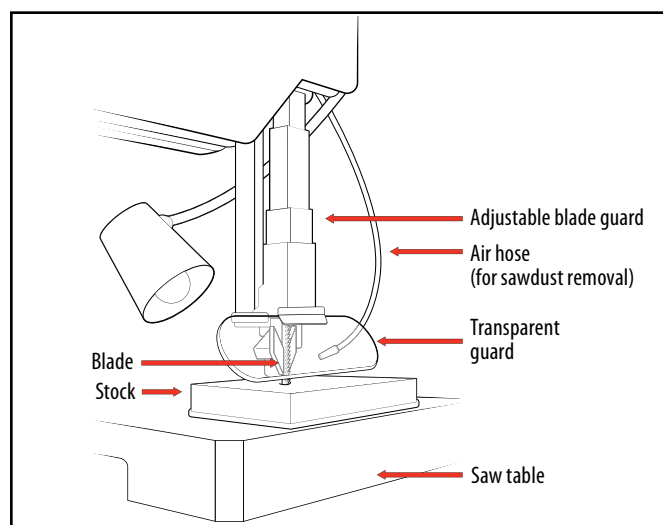


Figure 4.14. Typical band saw.

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### **Use and operation**

Band saws are used both for straight sawing and for cutting curved pieces. The band saw uses a thin, flexible, continuous steel strip with cutting teeth on one edge. The blade runs on two pulleys, one driven and the other an idler, through a hole in the work table on which stock is fed. The operator hand-feeds and manipulates the stock against the blade to saw along a predetermined line.

### **How injuries occur**

Although workers are not injured as frequently or as severely on band saws as on circular saws, injuries do occur. The most common injury is caused by contact with the blade. Contact with the blade at the point of operation occurs in two ways:

- The operator's hands may come close to the blade during cutting. A band saw cannot be completely guarded; the portion of the blade used for cutting is always exposed.
- The operator may contact the unused portion of the blade if it is not guarded (for example, when removing a cut piece).

### **Recommended engineering controls**

- Guard the blade entirely except at the point of operation (the working portion of the blade between the bottom of the guide rolls and the table).
- Use a **self-adjusting guard** for the portion of the blade between the sliding guide and the upper saw so that it rises and lowers with the guide.
- Properly adjust the blade guide post to fit the thickness of the stock and to provide additional guarding.
- Fully enclose the band wheels.
- Guard feed rolls if they are used as a method of feeding the saw.
- Consider installing a braking system on one or both wheels to minimize the potential for coasting after the saw has been shut off; otherwise, do not remove material until the blade has stopped.
- Make sure the saw includes a tension control device to indicate proper blade tension.

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### Recommended safe work practices

- Use a blade of an appropriate size and type. For example, do not force a wide saw to cut on a small radius.
- Set the guard to just clear the stock being cut.
- Never stop the saw too quickly or thrust a piece of wood against the cutting edge of the teeth after the power has been shut off.
- Periodically inspect blades; remove cracked or defective blades immediately.
- Make cuts only when the power is on and not when the saw is coasting.
- Use a push stick to control the stock when it is clearing the blade.
- Use a special jig or fixture when cutting small pieces of stock.

### Jointer

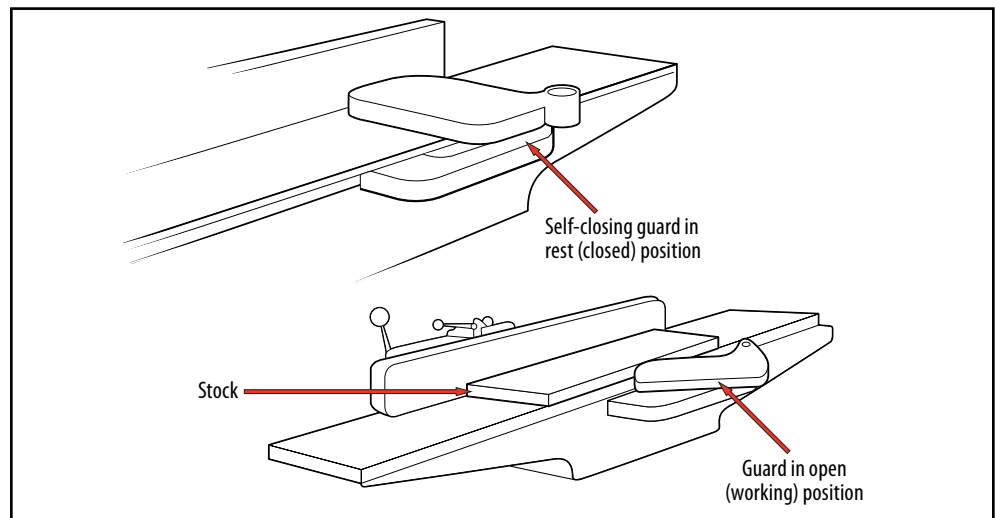


Figure 4.15. Typical jointer.

### Use and operation

Jointers face or flatten wood and are primarily used to joint small pieces of material. The operator passes stock over a cylindrical, multi-knife cutter head while keeping the stock flush against a guide (fence). The depth of the cut is achieved by adjusting the front table.

There are two types of jointers:

- Hand-fed jointers with a horizontal cutting head (Figure 4.15)
- Wood jointers with a vertical head

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### **How injuries occur**

Hand-fed jointers are dangerous woodworking machines. Injuries can occur if the operator's hands and fingers come in contact with the knives. This can happen when the operator is jointing narrow lengths of stock, particularly if a jig or other holding device is not being used. Injuries can occur when the operator allows fingers to ride along the surface of the jointer behind the stock as it is fed through. Sometimes stock may be accidentally kicked away, exposing the operator's hands to the cutter head.

### **Recommended engineering controls**

For **horizontal** hand-fed jointers:

- Enclose the cutter head with an automatic (spring-loaded, self-enclosing) guard that exposes the cutter head only when the stock is being fed. The guard must automatically adjust to cover the unused portion of the head, and it must remain in contact with the material at all times.
- Adjust the cylindrical cutter head so that the knife projects no more than 3 mm ( $\frac{1}{8}$  inch) beyond the cylindrical body of the head.
- Adjust the cutter head so that the clearance between the path of the knife projection and the rear table is no more than 3 mm ( $\frac{1}{8}$  inch).
- Keep the clearance between the table and the head as small as possible.

For **vertical** head jointers:

- Completely enclose the cutter head, except for a slot to apply the material for jointing. This guard can be part of the local exhaust system.

### **Recommended safe work practices**

- Use a hold-down **push block** when jointing wood.
- Avoid deep cuts. They increase the likelihood of kickbacks and require a larger table opening.
- As a general rule, avoid jointing short pieces. Never joint pieces of material that are shorter than four times the width of the bed opening.
- Check knives regularly for proper setting and adjustment, but only when the power is shut off.

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## Shaper

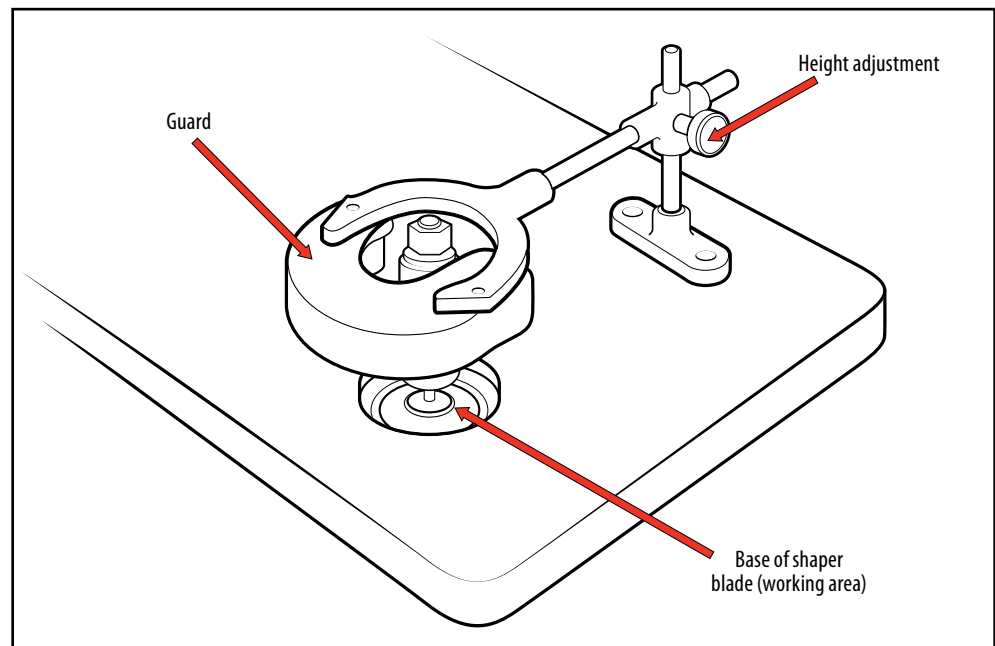


Figure 4.16. Typical shaper.

### **Use and operation**

Shapers are most commonly used to shape the edges of stock. The operator feeds the stock from any direction against a vertical rotating cutter mounted on a spindle. The spindle rotates at a high speed. Some machines have multiple spindles. Guidepins hold the stock for curved shaping, and fences hold it for straight-line shaping.

### **How injuries occur**

Injuries occur when the operator's hands or fingers contact the revolving knives. Workers can also be seriously injured or killed by tool projectiles resulting from unbalanced cutter heads. Shapers are difficult to guard, but a number of guards are available to protect the operator's hands.

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**Recommended engineering controls**

For horizontal hand-fed shapers:

- Figure 4.16 shows a spindle enclosed with an adjustable guard or cage. For straight-line shaping, the fence frame should include the guard. The fence should contain as small an opening as possible for the knives, and should extend at least 457 mm (18 inches) on either side of the spindle. Split adjustable fences are useful for guarding when the entire edge of the stock is to be shaped.
- Mount a ring guard around the cutting bit to reduce contact with the bit.
- Guard automatic feed rollers where present.
- Ensure that double-spindle shapers have a starting and stopping device for each spindle.
- Use a safety collar to minimize the potential for tool projectiles.

**Recommended safe work practices**

- Maintain the knives. Make sure they are precision-ground to apply uniform pressure, and that they are balanced and fit properly.
- Train operators to listen for “chatter” indicating that knives are out of balance. To start the machine, operators should apply the power in a series of short starts and stops to slowly bring the spindle to operating speed.
- Use templates, jigs, and fixtures to distance the operator’s hands from the point of operation. Featherboards may be clamped to the fence for straight-line shaping.
- Whenever possible, cut in the direction opposite to the spindle’s rotation.