



# What is **woodworking?**

Accident prevention in woodworking literally starts from the ground up — the floor. Whether you're cutting, drilling, shaping or sanding, you will perform the operation more safely in a clean, uncluttered workplace.

## **It's easier and safer to work in a clean area**

Remove sawdust, wood shavings and chips, and scrap lumber from the work area frequently throughout the day to eliminate slipping and tripping hazards.

Immediately clean up oil, grease and other liquids spilled on the floor.

Pieces of lumber extending into aisles, materials lying around machinery and improperly stacked lumber make performing your job difficult and create hazards.

The floor itself also can become hazardous. Loose boards, protruding nails, splinters, holes or other surface defects can result in serious injuries if you do not immediately report and correct them.

Wood used as raw material and wood byproducts — sawdust and shavings — are primary fuels for fires; so don't let them ignite. Keep switch enclosures, bearings and motors clean and free of sawdust. Store oily rags in a metal container with a tight cover.

All shop employees should know where to find and how to use the firefighting equipment in their work areas. The proper fire extinguishers should be quickly available to workers. If employees use fire extinguishers, employers must provide training once a year.

Store small tools, such as hammers, chisels, punches or drills, properly in the woodworking area to prevent accidents. Tools left on machines, for example, may fall off and cause foot injuries.

Never carry sharp or pointed tools in your pockets or use tools with burred or mushroomed heads. Check for and repair loose or damaged tool handles.

When handling small tools, follow these suggestions:

- Select the right tool for the job. Makeshift tools are dangerous;
- Sharp tools in good condition are safer;
- Give tools to co-workers by the handle first;
- Carry only as many tools as you can safely manage;
- When carrying sharp or pointed tools, keep sharp edges and points down and never put them in your pockets.

## **Stop machine completely when unattended**

Unattended machinery is dangerous. The safe worker makes sure the machine is completely stopped, not just switched off, before leaving it because an unsuspecting worker unfamiliar with the machine may touch the revolving cutting edge. All woodworking machinery should have a magnetic start and stop button. This type of control button will not allow the equipment to automatically start again if the power supply has been interrupted.

## **Shut off power and Lockout or Tagout machine**

Never clean, oil, adjust or try to repair machinery while it is still running. Before attempting any of these operations, shut off the power and lock the switch. Tagout machine when necessary. (Refer to OSHA'S Lockout/Tagout Standard 1910.147.) When cleaning a machine, use a brush or bellows to remove sawdust. Be sure to wear goggles.

## **Regular checkups prevent breakdowns**

Both supervisors and employees should frequently inspect all woodworking machines and safety equipment. Prompt discovery of developing defects permits timely correction and creates a safer shop. Regularly inspect ground connections on all portable and stationary electrically powered equipment.

## Appropriate clothing and personal protective equipment

Wear snug clothing to avoid catching on moving machine parts. Loose coats and sweaters are especially hazardous.

We recommend short-sleeved shirts or sleeves rolled above the elbow. Tie strings on shop aprons in back. Do not wear neckties or torn clothing.

Do not wear jewelry, including rings, wristwatches, necklaces, etc., in the woodworking area. Keep in mind that there are many ergonomically designed tools.

Safety shoes with metatarsal guards or plastic shoe guards will lessen foot injuries in lumber-handling operations.

Because of dust hazards or flying chips, wear safety glasses with side shields when operating cutting machines. For grinding and cutting operations, wear approved plastic face shields or goggles.

## Put safety first and efficiency follows

Whatever the operation, the safe way is the right way — and the efficient way. These general safety reminders provide a partial check list for everyday work habits:

- Know the safe procedures before operating any machine;
- Make sure all guards and safety devices are functioning;
- Ensure that the machine's exhaust system is properly working;
- Avoid reaching across moving machine parts;
- Limit your conversation while the machine is running;
- Do not force stock into the machine;
- Stop the machine completely before removing jammed stock;
- After turning off the power, do not attempt to stop the motion of the cutting edges with a stick or your hand;
- Know the locations of all emergency switches;
- Avoid horseplay;
- Wear approved eye protection;
- Get first-aid treatment for even the slightest cut or scratch.

## Circular saws

The two major causes of circular saw accidents are contact with the revolving blade or with material thrown by the saw. Proper training and the use of proper guards will diminish these hazards.

## All-around guarding for table saw

A table saw is safely guarded when the hood covers the saw blade to the depth of the teeth when: the hood adjusts to the thickness of the lumber and rides on it; the blade is covered beneath the table; the hood permits a clear view of the cutting point; the guard is designed and constructed to eliminate vibration and contact with the blade. (If the hood is in a fixed position, the space between the bottom of the guard and the wood being cut should not exceed 3/8 inch.)

## Preventing kickbacks

The hazard of material thrown by the saw blade — splinters, splinters and stock — is reduced by the use of a properly mounted and designed spreader and an anti-kickback device.

Rigidly mount the spreader 1/2 inch from the blade. It should be 2 inches or wider at the table level and high enough to cover the full thickness of the lumber being cut.

For safety in ripping operations, hinge non-kickback fingers on the spreader and keep them sharp.

## When standard guards are not practical

Easily made jigs and featherboards are the practical answer when special operations make it impractical to use standard guards.

When rabbeting and dadoing, for example, you can lock the work in a jig that moves in the grooves of the transfer guide. Operators should keep their hands away from the point of the cutting operation.

Featherboards are quickly set up for short runs. The featherboard should bear against the stock at approximately a 45-degree to 60-degree angle. When used in ripping operations, the board should press against the stock so that it is not forced against the saw. When dadoing, place the featherboard opposite the cutting head.

### Keep hands away from saw blade

When sawing short or narrow stock, use a stick to push the pieces through. Using your hand to feed short or narrow pieces is asking for trouble. For obvious reasons, never do work freehand; hold the stock against the gauge. When you hold lumber so that your hand is directly in line with the saw blade, the slightest miscalculation of material distance or vibration can result in your hand contacting the blade.

Because of the ever-present danger of kickbacks, always stand so that your body is out of line with the stock being cut.

If other workers are regularly working in line with the saw and might be hit by kickback material, use a heavy metal or plank barricade to protect them.

### Caring for the blade

When you use an emery wheel to sharpen or gum the saw blade (deepen and round the gullets between the teeth), a free-cutting wheel works best. When setting the teeth, see that the set is in the point of the teeth. When storing the blade, select a place where there is no danger of accidental contact.

If sawdust is not discharged freely, check the depth, size and shape of the gullets. The bottom of each should be round.

When mounting the blade, see that there is no end play or lateral motion in the arbor. Be sure that the collar and stem of the arbor fit perfectly. Check the running speed before mounting; the speed is marked on the blade by the manufacturer.

### Use proper blade height

Safety recommendations vary. Some authorities suggest no more than three teeth be exposed above the stock being cut; some suggest a maximum of 1/8 inch of the blade be exposed above the stock; still other limit exposure to 1/16 inch above the stock. In any case, do not set the saw higher than necessary to cut through the stock because the lower the saw is set, the lower the angle of the saw is to the feed table. This reduces the chance of kickbacks.

### Select the saw for the job

Using the right saw makes the job easier and safer. Do not do work that requires special machines, for example, on a general purpose table saw. Do not crosscut long stock on a swing or pull saw. When cut on a table saw, the stock extends beyond the safety area and creates a hazard for other workers. Guiding such stock is difficult and increases the hazard for the operator. Get help when you must handle long material.

### Check each blade before use

Dull, poorly set, improperly filed or improperly tensioned saws, and gum adhering to blades are all hazards. They can cause the material to jam or stick, stall the saw or kick back. Follow instructions provided by the saw manufacturer for proper maintenance. If used properly, a good saw will not twist, burn, snake or kick back. When continuously using a saw, inspect the blade for cracks.

Each time you sharpen the blade (filed or set), check the blade for cracks. Most cracks start in the gullets of the teeth; cracked saw blades could eventually fly apart. When removed from service, you can repair the blade by welding or slotting to remove the crack, making other slots to balance the blade and then retensioning. Unless a skilled sawsmith is available, return the blade to the manufacturer for welding, slotting and tensioning.

Chapter 4121:1-5-08(E), published by BWC, prohibits the use of a cracked blade.

Prevent cracking can be prevented by:

- Making sure the saw is tensioned for the speed at which it is to be run. If not properly tensioned, the blade will wobble and vibrate, causing it to heat, expand and crack;
- Ensuring the blade is straight, not warped or out of round. Tooth length must be even;
- Checking to see that the blade is perfectly balanced;
- Making sure the teeth have sufficient clearance;
- Ensuring the teeth do not become case hardened, blued or glazed;
- Making sure the saw is sharp.

## Swing cut-off saws

You must observe most of the precautions for using table saws when using overhead swing saws. Also, take special care to avoid hand injuries — the saw moves forward from the idle position, or drifts forward because of the failure of the counterweight.

When properly guarded, the swing saw has a fixed hood over the top half of the blade and the arbor.

If the counterweight that returns the saw to its original position does not encircle the bar, attach a safety chain to it. Inspect the chain periodically for wear. Do not use rope, cord or springs.

A limit chain restricting the travel of the saw to the front edge of the table is a safety must.

To prevent rebound from the idle position, attach a latch with a ratchet release on the handle or use a nonrecoil spring.

When operating the swing saw, stand on the side where the pull handle is located. Feed work to the saw from that side also. If you must feed stock from the other side, add a second pull handle to keep your body out of line with the saw.

For safety's sake, always check the saw for a positive hold in the idle position before putting your hands on the saw table. Measure boards with a stop gauge; measure with a rule away from the saw.

## Underslung cut-off saw requires special precautions

Whatever name you use for these saws — underslung cut-off saws, inverted swing cut-off saws or jump saws — employees operate them by a foot treadle. This is an added hazard, unless you guard it to prevent the saw from being tripped accidentally.

Safety also demands that the blade be completely enclosed when the saw is in the idle position. When it moves forward, a hood guard should cover the blade that slides on the table top and rests on the stock when the saw is cutting.

When using the saw, your hands are close to the line of cut. For safety reasons, construct a barrier guard on both sides of the line of cut, high enough off the table top to admit the stock, but not your fingers or hands.

## Radial arm saws

Radial arm saws are versatile—they can be adjusted for many operations. But these adjustments create additional hazards that must be avoided.

You must not violate this rule: NEVER MAKE ADJUSTMENTS WHILE THE SAW IS TURNED ON.

The radial arm saw should have an upper guard strong enough to protect you from flying splinters, broken saw teeth and other hazards. A disc guard that adjusts to the stock should guard the lower portion of the blade on both sides. Limit movement of the saw to prevent the blade from extending beyond the edge of the worktable.

OSHA requires the blade must stay in contact with the stock material at all times.

Because you can adjust the radial arm saw for bevel, diagonal, compound bevel, rip or miter cuts, only assign a trained operator to this machine.

The hood should indicate the direction the saw blade rotates. Raise the beam slightly at the free end so that on release the saw returns to the starting position without rebound.

For ripping operations, anti-kickback fingers are essential.

Safety idea: Affix this warning sign to the hood — DO NOT RIP FROM THIS END.

Many accidents involving radial arm saws are caused by the coasting of the blade after power is shut off. Use a braking device; don't try to stop the blade by holding a piece of wood against it. Besides possibly injuring the operator, this practice can crack or warp the blade or cause it to lose temper.

## Band saws

While operating a band saw, your hands must come close to the blade. It is imperative that you adequately light the point of operation.

The danger of kickbacks is not present in the band saw, making it easier and somewhat safer to operate.

Safety requires guarding of the blade as much as possible at the front and sides, but vision at the point of operation cannot be hampered. Many shops use a shaped plastic shield that affords exceptional visibility.

The upper and lower wheels of the band saw, between which the blade travels, and the portion of the blade above the guide, should be fully enclosed. OSHA requires a closed cut by the blade under the table. Be sure all guards and the blade guide are in place before starting operations.

## Check blade tension before use

Proper blade tension is vital. If the machine does not have an automatic tension indicator, you must check the blade tension with your fingers. If anything seems wrong, have an experienced mechanic check it. Temperature has an effect on blade breakage. Because cold saw blades break more easily, don't use a band saw in temperatures less than 45 degrees Fahrenheit.

Check the blade for kinks or cracks and see that it moves freely and smoothly. A cracked blade will make a clicking sound as it passes through the guide. Immediately remove kinked or cracked blades. An experienced mechanic can remove twists or kinks with a hammer; the mechanic also can reinstall the blade.

Saw teeth must cut on the downward stroke. Adjust back rollers carefully to the normal position of the saw blade.

Follow these reminders when using a band saw:

- Use as large a blade as the work permits;
- Don't stop a band saw too quickly; it may snap the blade;
- Stopping the saw by forcing a piece of wood against the teeth after the power is off is a dangerous practice;

- Be sure that the upper and lower guides are properly adjusted;
- If the work binds, stop the saw before backing it away from the blade;
- For safe and efficient operation, keep the band saw wheels clean. Avoid accumulations of sap, gum or resins;
- Keep the wheel guards closed at all times to hold the saw blade if it breaks;
- Store extra blades out of the way to prevent accidental contact.

## Jig saw safety precautions

Jig saws can cause injuries. When a blade snaps, it has considerable force.

To avoid blade breakage, follow these precautions. Attach the blade securely and properly, with the teeth cutting on the down stroke. Place the hold-down rest firmly on the stock. Before switching on the power, safety check all adjustments.

Be sure to use a sharp, properly set blade. Avoid crowding or bending the blade on small turns. Use small blades for small radii cuts. Plan your cuts to avoid backing out of curves.

## Jointers

The majority of jointer accidents occur while working with short stock. The minimum length of stock should be four times the width of the bed opening.

Safety standards require a cutting edge that projects no more than 1/8 inch beyond the cylinder body. The table opening should not exceed 2 1/2 inches when the tables are aligned for a zero cut.

## Keep guards in place

Before operating the machine, make sure the guard is in place. It should cover all the cutting head on the work side of the fence. When in operation, the guard should automatically cover all the unused portion of the head and ride with the stock at all times.

Keep the portion of the cutting head behind the fence enclosed at all times.

Some surface work guards move vertically during surface jointing and horizontally during edge jointing.

A leg-of-mutton swinging guard is good protection for edge jointing. This type of guard will allow exposure from too much of the cutting edge as the end of the stock passes over it. To avoid the hazards of revolving cutters, use a pusher block of the proper size to accommodate the width and thickness of the stock being used.

### Precautions prevent injuries

- Use jointers only on relatively narrow material.
- When doing surfacing work on a jointer, keep both hands on top of the stock; keep hands off the front or back edge.
- Because of the danger of kickbacks and the hazards of a larger table opening, avoid heavy cuts.
- Ensure openings between the tables and the cutting head are just enough to clear the knife.
- Do not travel with the work as it passes through the machine. Stay at the left side of the machine beside the front table.
- Make sure the knives are sharp, perfectly balanced and securely fastened.
- Keep the table free of all material other than the work stock.

### Shapers

Because of the variety of tasks performed on a shaper, there are a number of guards available — vertically adjusted, hinged, pressure, and ring and cap guards. All of these cover the spindle top and surround the knives, allowing just enough clearance for the stock.

Each guard's purpose is to keep the operator's hands away from the knives. A leather warning device attached to the spindle is not a safe guard. Circular guards should have a diameter not less than the maximum diameter of the cutter.

Where the nature of the work allows, we recommend jigs, fixtures and templates. Always use jigs when working with narrow stock. Hand-holding narrow stock brings the operator's hands too close

to the knives and causes the greatest number of shaper injuries.

Shapers present unique hazards. If a knife breaks or is thrown from the collar, the other knife generally follows. When thrown, these knives have enough force to kill.

### How to eliminate the danger of broken or thrown knives

Here are a number of ways to prevent blades from breaking or flying from the machine:

- Use knives made of the best shaper steel;
- Use blades and collars that are precision ground to exert uniform pressure on all knife blades;
- Use blades cut to accommodate the stoppins recommended for the collar;
- Do not use a knife when the butt end does not extend beyond the middle point of the collar;
- If possible, use a solid cutter that fits over the spindle;
- Use a special safety collar that has a shoulder welded on the end of a groove to match a similar shoulder ground on the knife;
- Avoid deep cuts;
- Bring the spindle up to the operating speed in a series of short starts, listen for chatter and watch for signs that the knives are unbalanced.

Use an automatic brake that stops the revolving head when power is switched off. If the machine is not equipped with the brake, never attempt to stop the spindle by grasping it.

Start double spindle shapers one at a time. If one blade is removed from the spindle, remove all blades to avoid the hurtling of the remaining blades if the machine accidentally is started.

Be alert for knots and cross grain in stock — they could cause kickbacks or throw your hands into the knives. Keep your hands off the edge or near the edge of material. Never back up on a cut; take the stock away and make a new start. Use a fence and pressure bar whenever possible.

## Planers

A planer is a fast and powerful machine. Cover cutting heads with metal guards while the machine is operating. You should also enclose drive belts and pulleys with metal guards to avoid accidental contact.

Feed rolls require a sturdy metal hood or bar guards to prevent the operator's hands from coming into contact with the in-running rolls.

You cannot entirely eliminate kickbacks, a hazard of this woodworking machine, with safety devices. The operator can exercise some control over kickbacks by not feeding boards of varying thicknesses simultaneously, because the thinner stock may not be held by feed rolls and may be kicked back by the cutting heads. The operator must never stand in the line of board travel.

The exhaust system always must be in good working order. Goggles or face shields protect the operator from splinters and chips that may be thrown back by the cutting heads. Hearing protection also is necessary.

If a board stalls in the machine, never look into the front of the planer. Serious eye and face injuries can result from flying knots and splinters.

Other precautions for safe planing operations include wearing leather hand pads, not gloves, when handling rough lumber; keeping the feed rolls, chip breaker and pressure bar properly adjusted; checking the knives for sharpness and security before starting the planer; and keeping obstructions and other workers clear of the finish end of the machine.

## Sanders

Because of the unusual amount of dust involved in using sanding machines, it is imperative to equip sanders with efficient exhaust systems. Place the intake duct always as near as possible to the point of the sanding operation. Locate it so that the natural air flow from the belt or drum is directly into the exhaust system.

Frequently, the exhaust hood is the entire or partial guard on the sander.

Ensure the exhaust hood on a drum sander encloses the revolving drum. The only exposed section of the drum should be the working area.

Ensure the exhaust hood on a disc sander encloses the revolving disc with only the working point exposed above the table. Place the table as close as possible to the disc.

On belt sanders, provide sheet metal guards that serve as part of the exhaust system at each point where the sanding belt runs onto the pulley. Also, guard the unused run of the sanding belt to prevent contact by the operator or co-workers.

Self-feeding sanding machines should have a semicylindrical guard over the feed rolls to prevent contact of the operator's hands with the in-running rolls. There should not be more than a 3/8-inch space between the guard and the plane created by the contact face of the feed roll at the point where it touches the lumber.

### Drum sanding precautions

- Set the drum sander for small cuts.
- If stock catches on the edges of the bed, stop the machine.
- Keep your hands off the machine in operation.

### Disc sanding precautions

- Secure the disc and table firmly in the proper position.
- Sand only on the down stroke of the disc and hold the stock firmly against the bed stop.
- Keep your hands away from the disc.

### Belt sanding precautions

- Keep the stock resting firmly on the machine bed stop.
- Hold the sanding blocks squarely, firmly on the work and away from the belt edges.
- Be alert for breaking belts when sanding small, irregular stock.

## Woodworking lathes

Safe work habits can overcome most hazards associated with wood-turning lathes when the work is done with hand tools. When mechanically held cutting heads perform the cutting, the combination of good operating practices and proper guarding is essential.

### Turning with hand-held tools

The major hazard when hand-held tools are used arises from the possibility of breakage or loosening of the faceplate work. To avoid this hazard, securely fasten the stock to the plate, make sure the speed of the lathe is within safe limits for the job, avoid heavy cuts and give special attention to defects in the material that may snag the cutting tool.

Simple turning between centers also creates hazards. Hands may be injured if the tool rest is not removed before sanding is begun. A safe way to do this type of sanding is to press a sandpaper pad against the work underneath or pass a strip of sandpaper, held by the ends, over the top of the stock.

### Turning with production lathes

Safety demands guarding the cutting heads. Either hood or shield guards should cover the cutting heads as completely as possible. The guards should be hinged for convenience in making adjustments. When long stock is held between two centers, provide long, curved guards extending over the top of the lathe to prevent the stock from being thrown from the machine.

In addition to the guards, connect efficient exhaust systems to the lathes by suction hoods. Chips and dust are then removed at the point of origin.

### Good habits

- Fasten material securely to faceplates or hold properly between centers.
- Never use a gouge on inside turning; it may catch and turn.
- For faceplates jobs, saw the disc-shaped piece accurately round; otherwise, the unbalanced piece could fly out of the lathe.
- Always turn off the lathe before testing the stock, making adjustments, testing for smoothness or using calipers.

- Inspect the stock for checked ends, poorly glued joints, knots and other defects.
- Check the tightness of tailstock and faceplate screws.

## Edger machines

The safe operator is extremely cautious when working around feed rolls because fingers and hands can be crushed if caught by the rolls. A safety stop-bar installed across the in-feed of the machine helps protect the operator. This safety bar is designed to stop the rolls when force is exerted on the bar.

To avoid contact with the feed rolls, a safe operator avoids wearing loose or ragged clothing, riding hands on the lumber and pulling the cants against the guide. Be sure to wear hearing protection while operating the machinery.

### Safe controls

The location of the edger controls affects the operator's safety. Therefore, locate controls so that the operator is above and to one side of the edger. In this safety position, the operator obtains a better view of the lumber, increasing the efficiency of the operation.

Kickbacks can happen on any edger. Properly installed and maintained anti-kickback fingers give effective control of the kickbacks.

## Boring machines

Guard the twisting action of boring machines, wherever practical, to avoid catching the operator's clothing. Operators with long hair must wear protection. A simple barrier across the battery of bits may be effective on multiple boring machinery.

Drill press operators can contribute greatly to their own safety by:

- Using only properly sharpened bits;
- Removing the wrench from the chuck before starting the drill;
- Never reaching around the drill;
- Always clamping the work;
- Avoiding feeding the drill too fast;
- Never using wiping rags around the revolving bit;
- Always running the drill at the proper speed for its size and the kind of material being drilled.

From an equipment standpoint, safety calls for the use of safety-bit chucks with no projecting set screws, completely enclosed universal joints on the spindles of boring machines and inverted U-shaped shields over the operating treadles or treadles located to prevent accidental starting.

### **Mortising machines**

Improper operation of the mortiser can result in injury to the operator and damage to the machine.

Ensure the operator's safety by observing common sense precautions. Be sure the work is securely clamped in position. Check the bit and chisel for proper and secure setting. Hand turn the machine one complete revolution before turning on the power. Keep your hands away from the chisel while the machine is operating.

Guard the operating treadle to avoid accidental starting. In the case of a chain mortiser, guard the top of the cutting chain and driving mechanism. All mortising machines, except hollow mortisers, should have thumb stops at each side of the chisel.

### **Tenoning machines**

Adequate guarding is a must on tenoning machines. Cover all cutting heads, including saws, except at the point of operation. The exhaust hood can do double duty as part of the guard.

Chain-feed machines, such as double-end tenoners, should have proper guards over the feed chains and sprockets, except for the portion of the chain used for conveying the stock.

It is especially important that guards on the cutting heads and saws of combination machines prevent contact at any point on the topside and underside of the machine. Without proper all-around guarding, it is hazardous for a worker to go beneath the machine to make repairs or adjustments.

It is imperative that you can lock starting switches in the off position whenever work is done on the machine. Because of the length and complex design of combination machines, the person making repairs may not be visible from the operating position.

Combination machines also should have a starting button for each cutter head; the heads should be switched on separately. Because the operator may not always be at the feeding end, stop buttons for all cutter heads should be available at several locations on the machine.

Here are a few general safe practices for operating tenoning machines:

- Use the hold-down lever on hand-fed tenoners to keep the work under pressure while cutting;
- Do all cutting while the sliding bed is moving away from you;
- Be sure the knives are free to turn and all adjustments are secure;
- Do not tenon sections of stock that have knots;
- Keep your hands out of the knife zone.

### **Other machines router**

Safe operators use turn plates, jigs and fixtures to keep their hands out of the point of operation and see that proper guards are in place over pulleys, spindles and cutting tools.

### **Drag saws**

Safety demands a four-foot clearance for passage around a saw when it is at the extreme end of the stroke; or the saw and driving mechanism should be enclosed.

### **Veneer clippers**

When wet veneer curls or doubles over and you must push it down to get it under the knife, push with a stick, not with your hands. When there is no automatic feed, place a guard there to prevent placing fingers under the knife while feeding the stock. Enclose slat-belt conveyors or sprockets on chains.

### **Glue spreaders (roll type)**

Check to see that the bottom of the guard comes within 3/8 inch of a plane formed by the contact face of the roll where it touches the stock. Whatever the machinery, adequate guards, and often exhaust hoods, are required for safety. Other important factors for operator safety include a knowledge of the operation of the machine, awareness of the hazards present and faithful adherence to the safety procedures.