

U.B.C. School of Architecture Workshops

Power Tool Orientation

This document is meant to give a text overview of the correct use of the power tools in the SOA workshop. It is intended to augment and not to replace the orientation session(s) that anyone wishing to use the workshop must attend, nor specific instruction on particular tools or machines. If you have any doubts about the correct use of any tool in the workshop please don't hesitate to ask the technician.

POWER TOOL THEORY

Certain properties are common to most stationary power tools. Most machines use some variety of a table, a blade, and a fence, requiring the secure movement of material resting on the table along the fence through the blade. (The chop saw and the drill press are two tools in which the blade rather than the material moves and the band saw and the scroll saw can be used without fences). In general, the cutting blade wants to push material away from itself (generally towards the operator), and this is countered by the slow and steady movement of the material into and past the blade. Many problems of safety and accuracy occur when the operator loses control of the material allowing it to come away from the fence, or the blade is allowed to push material back towards the user.

BEFORE BEGINNING

- Operators of power tools must always wear safety glasses. Ear protection and dust masks are highly recommended.
- Turn on the dust collector.
- Check material for embedded nails, staples, screws, or small stones.
- Ensure the tool that you are about to use is in good repair and safe. If in any doubt ask the technician. Remove any unnecessary objects or debris from the machine. Make sure the electrical cords of portable power tools are not tangled or underfoot. Before using any tool make sure all the safety guards are in place and functioning properly. Use all the safety guards whenever possible.
- Don't let anyone distract you when you're operating a machine. Keep your full attention on what you're doing.
- If the piece of material you are cutting is large and/or heavy and is difficult for you to handle alone, ask for help. It is common for 2 people to be needed for awkward operations.

- The following tools and machines are introduced in the order they might typically be used for the breaking out (cutting to size) and milling (thickening or molding) of rough or large stock. Naturally not all materials or projects require the use of all tools, nor in the order presented here. Much work is accomplished by going back and forth between tools.

DUST COLLECTOR

The dust collector collects chips and saw dust from the machines. The collector must be on whenever a machine is used; otherwise accumulation of chips or dust may jam the tool or create an unsafe situation - let alone filling the workshop with clouds of dust!

The School has installed a very powerful, dust collection system. It exhausts the dust and chips into hoppers in a room in the parking garage. Because of its power all of the blast gates can stay open all the time. The switch is located on the wall diagonally opposite the workshop office. The green button turns the machine on, the middle red button turns it off. The machine can be controlled from two locations so if it doesn't get off when the stop button is pressed, don't worry, it means someone is using it from a different location.

One of the other switches is located in Room 4 on the outside wall of the CNC Room. It is primarily intended for the CNC machine but students using Room 4 should turn it on if they are using the disc sander.

THE CHOP SAW

The chop saw is used to cut material to length at a variety of angles. For pieces wider than 11" use the sleds on the table saw.

Preparation:

- Always hold the **desired material to the left of the blade** with the **waste to right of the blade**. If



this piece is too small to be safely held, you should be using the table saw with a sled. (See "Table Saws") If using a clamped stop block for multiple cuts, it is particularly important that the piece between the blade and the stop block be securely held during the cut, to avoid kickback.

- Keep hands away from blade.
- Check angle settings. (The gauge on the saw is approximate.)
- Check material for warp. Any crown (high spot in a warped board), should be down and back.
- Small work can often be better done using a sled or miter fence on the table saw. If using the chop saw a long straight piece of wood can be placed on the table behind and/or beneath your material as a temporary fence and/or table. This piece should be wide enough so you don't cut all the way through it. This also prevents tear out on the back and/or bottom side of the material. This method also gives an accurate position of the line of the cut which makes lining up subsequent cuts easier.

- Ensure that no one is standing behind you at 4 o'clock. Small off-cuts may kick back in that direction.
- Turn on "laser marker" light using switch on the top of the D handle. This creates a line of red light in line with the left side of the cut which can be used to line up with a mark on the material to be cut.

C U T T I N G :

- Start motor before lowering blade by pressing the thumb safety button and squeezing the trigger.
- Push blade slowly into material until it is completely through.
- Raise blade out of material and release trigger.
- When blade is stopped, remove material.
- On the sliding chop saw start the machine and gently pull the saw out far enough to begin cutting at the near edge of the material – never pull while cutting. Slowly guide the blade down and back to achieve the cut.

T A B L E S A W S



The table saw is often the centre of the shop in terms of both layout and use. It is the largest machine in many shops, requiring the most infeed and outfeed space and has a versatility that allows it to be used for several stages of construction. It can do most basic cutting jobs as well as a good deal of refined milling and joinery work. With a sharp blade it will give a straight, relatively clean cut.

This machine can rip, (cut along the material's length), using the fence, and crosscut, (cut across the material's shorter dimension), using a special sliding fence or sled. It can handle full sheets of plywood and plastics, and with special blades, be used to cut soft metals. The blade can be raised or lowered by means of a wheel at the front of the base. It can be tilted by means of another wheel on the left side of the base. The degree to which it has been tilted is roughly indicated on a scale at the front of the base.

We have 2 table saws which have a unique safety feature. If the blade contacts any object that will conduct electricity better than dry wood (a poor conductor), it will brake to a stop and retract into the table. This occurs within a few milliseconds which means that if a finger is brought into contact with the spinning blade the probable outcome will be nothing more than a small cut. The braking feature while a great advantage safety wise makes for some complication in the operation of the saws. For example, materials

that conduct electricity like metals or wet wood must be cut with the saw in “bypass” mode. If you are unfamiliar with the new saws speak to the tech. before starting.

Near the blade are two safety features: a splitter, which is behind the blade and in line with it; and a guard, which is the large yellow hood over the blade. The splitter has several uses; it serves to prevent the material from coming away from the fence, it stops material from squeezing the blade; and finally, it prevents kickbacks. The blade guard prevents users from inadvertently coming into contact with the spinning blade and also serves as a suction point for the dust collection system.



In the case of cutting rough sawn or warped solid wood, planing and jointing should be performed before using the table saw. Never try to cut wood that’s warped or on which the edge running against the fence is not straight.

RIPPING

Ripping is the process of cutting in the longer dimension of the material. With solid wood and plywood it means cutting parallel to the grain. This is one of the most common uses of the table saw and the machine is fitted with a “rip” fence for this purpose. The fence can be locked into position parallel to the blade. The distance between the fence and the blade is read under the hairline window to the right of the fence. (This hairline may need to be reset if the blade has been changed). Gentle downward pressure on the lever locks the blade in position. It is a good idea to check the hairline again to ensure that you still have the correct distance.



For any cut less than 6” wide a push stick should be used to push the material past the blade. For cuts less than about 1 ½” wide the blade guard will need to be slid out of the way, and for cuts less than ¾” wide the riving knife removed so the push stick can pass by the blade. **Check with the technician for these cuts.**

Preparation:

- If material to be cut is wet or may have metal in it let the tech know so that the braking system can be bypassed.
- Set fence to desired measurement.
- If needed, ensure a push stick is near your right hand but not in the way of the cutting.
- Adjust the blade to ¼” to ½” above the material and ensure the blade can turn freely.
- Ensure exhaust system is running. Turn on table saw.
- Stand behind the material and to the left facing one o’clock. If the material is longer than about 4’ stand close to the machine with the material extending past your right side.

- Place material on the front of the table .

Cutting:

- Use your left hand to hold the material down and against the fence and your right hand to advance the material into the blade.
- Once cutting has begun, ensure that the material never comes away from the fence, and that it is running flat on the table.
- Never let go of the material once cutting is under way. If work binds or starts to jump or chatter, it is a sign that you are not controlling the material. Letting go may cause it to “kick back” and come flying toward you. In this case hold the work as securely as you can and use your knee to press the “off” button of the switch. If this is not possible call for someone else to shut the machine off.
- **For cuts more than 6” wide.** Once the left hand comes into the vicinity of the insert plate around the blade remove it and continue pushing with the right hand past the blade until the material is completely clear of the blade.
- **For cuts less than 6” wide:** Once the back end of the board has moved onto the table, hold material securely with the left hand while picking up push stick with the right hand. Use it to continue pushing the material through the blade. As the left hand approaches the insert remove it from the material and use the push stick to push the material until completely clear of the blade.
- For cuts less than $\frac{3}{4}$ ” the blade will cut through the push stick as the back of the board goes through it. This is fine. Make sure the blade extends only $\frac{1}{4}$ ” above the material to reduce its cutting into the push stick. If the push stick has been used several times before at different fence settings it can become quite “eaten” away. If this is the case throw it away and get a new push stick.
- In every case remove cut piece by walking around to the side or back of the machine. Do not reach across the blade.
- When finished with a setting, turn off the machine before resetting.
- When finished with the machine turn it off and clean off machine and surrounding floor.

CROSS CUTTING

Cross cutting involves cutting across the shorter dimension of your material. It can be done using the miter fence or a sled, both of which slide on rails which fit into the grooves which run front to back across the table of the saw.

The miter fence is essentially a short fence attached to a single rail. It can be swiveled to 45° in either direction. To obtain a cleaner cut and to more easily cut to a mark, a long straight piece of wood may be screwed to the front surface to create a fence that the blade can cut into. The resulting saw kerf can be used to line up cuts.

Sleds are auxiliary tables with a fence attached that slide past the blade on one or two rails. They are useful for cutting wider pieces of material since the material is still supported on the extra table even when the sled is pulled back, part way off the saw. We have two shop built sleds that are usually confined to 90° cuts (although they can be built or altered to cut in a variety of ways), and one commercially built sled which can be angled.

Preparation:

- If material to be cut is wet or may have metal in it let the tech know so that the braking system can be bypassed.
- Move rip fence to the side. It generally isn't used for cross cutting.
- Place miter fence or sled on table and insure that the rails are sliding freely in the grooves.
- Place material against fence.
- Adjust blade to ¼" above material.

Cutting:

- Turn on machine
- Hold material securely against fence while pushing miter fence or sled past blade. Make sure your hands are away from where the blade will cut.
- Never let go of material once cutting is underway.
- When blade has cleared material, slide material sideways away from path of blade. If this is not practical turn machine off and walk around to remove material.
- Pull back device.
- Repeat as necessary. When finished, turn off saw, remove miter fence or sled, and clean up area.

JOINTER / PLANER

The jointer and planer are used only on solid wood to create flat, parallel sides. They cut a thin, controlled layer of wood from the board by means of vertically spinning cutters.



The jointer removes material from underneath the board. Varying the difference between the planes of 2 parallel tables – the “infeed” and the “outfeed” - controls how much material is removed. By keeping the cut surface pressed to the outfeed table as the wood is fed over the cutter, a straight, flat surface can be obtained.

Once one surface is flat, the jointer can create another one at a precise angle (usually 90°) to it by means of a fence that rises up from the tables. The first flat surface is slid along the fence while the jointer flattens the second.

In order to make sides opposite the ones jointed parallel to them and at a precise distance away the planer (or thicknesser) is used. In this machine the cutters are above the work, which slides under them on a bed that can be raised or lowered. Rollers in front of, and behind the cutters control the movement of the wood through the planer. Numerous passes remove material until a flat, straight surface is obtained, and can be continued to achieve a desired thickness.

Because using these tools is quite tricky, this guide does not have step-by-step instructions. If you need to use them please schedule a lesson with the technician.



B A N D S A W S

Although the table saw is considered the centre of the shop, the band saw is a quiet and very versatile machine. It requires fine-tuning, a sharp blade, regular maintenance and gentle use. The uses of the band saw and table saw overlap, allowing you to perform similar work on either machine.

The blade is a toothed loop of flexible steel tracking around 2 wheels and controlled in the cutting area with upper and lower guides and support bearings. With the fence, this saw can rip boards and cut thin veneers. Without the fence, it can cut curves and circles. With the mitre fence it can crosscut. And like the table saw it can be fitted with various jigs to increase its versatility.



The adjustment that is most often required is to raise or lower the arm which carries the upper guides and exposes the amount of blade appropriate to the thickness of material being cut. The band saw is able to cut curves of varying radii depending on the width (front to back) of the blade. The narrower the blade is, the tighter the curve. If the blade on the machine will not cut the radius you want see the technician.

The table (bed) can be tilted to make angle cuts. See the technician.

We have three band saws: A large one, which is usually fitted with a wide blade and is used for straight cuts, ripping, and resawing (cutting thick boards thinner); and two smaller ones which are used for curved cuts and generally for smaller pieces of material.



R I P P I N G

Preparation:

- Make sure dust collector is on.
- Set the fence to the desired measurement. The large band saw has a single knob to lock the fence; the small one has two knobs, a large one to lock the front of the fence and a small one to lock the back in that order. - both need to be used.
- Adjust the guide arm to the material thickness. The guide should be about ¼” above the thickest part of the material being cut.
- Ensure that a push stick is with-in reach if ripping less than 4”.

Cutting:

- Turn on machine.
- Stand close to machine, facing 11 o'clock.
- Feed material slowly. The right hand is used to hold the material down and into the fence. The left hand advances the work.
- If using a push stick: Near the end of the cut secure material with right hand and pick up push stick, using it to push the material past the blade.
- Walk around machine to retrieve cut piece. Turn off machine. Clean area. Turn off dust collector.

CUTTING WITHOUT A FENCE

Preparation:

- Move fence out of the way.
- Adjust guide arm to material thickness.
- Turn on machine.

Cutting:

- Stand close to machine facing straight ahead.
- Feed material slowly pushing material with both hands so as to follow your line.
- Do not rotate material without advancing it: The blade can only cut on the leading edge so you will only cause burning and possibly break the blade.
- Ensure that your hands are clear of the spot where the blade will emerge from the back of the material. If necessary use a push stick.

SCROLL SAW



The scroll saw uses a tensioned reciprocating blade to cut. The material is slid over a table similar to that of the band saw. The scroll saw is usually used without a fence. The reciprocation speed can be varied by altering the belt and pulley configuration and the table can be tilted. Because of the narrow blades available and the amount of control possible over blade tension and speed, this machine is good for making fine curvy cuts through thin material.

Although it is designed to be used with scroll saw blades which are attached at both the top and bottom, we have been using it with standard jig saw blades which, being attached at the bottom only, make it easier to use the saw to cut pieces out of the center of a piece of material.

Preparation:

- Clear table of debris. The scroll saw is not connected to the dust extractor so ensure that you have a dust mask. Check that blade type and width is appropriate to the job. Check cutting speed. If in doubt ask.
- Adjust the hold-down spring on the pressure foot. Adjust the tension so the material is held flush against the table, but so it can be moved freely under the pressure foot.

Cutting:

- Turn on machine. Slowly feed material into the blade. Don't force the cut. Twisting the blade or putting too much pressure on it will break it.
- Keep your fingers away from the area in front of the blade. Try to hold the material to either side of the blade while avoiding compressing blade in the saw kerf.
- If you have to back out of the cut, hold the material firmly with one hand while you turn off the saw. When completely stopped, pull the material gently back past the blade. Don't twist or force it.
- When finished turn off the machine, retrieve your pieces and clean up the area.

SANDING MACHINES

Sanding machines use abrasive belts, discs and drums of various grits to shape and smooth wood and plastic. Power sanders are deceptive because although generally simple to use they can quickly ruin work. You must pay close attention to avoid oversanding.

These machines can also cause nasty injuries. The wound left by contact with a rapidly moving abrasive is painful and slow to heal. The pressure used to hold work into the sander will also force hands into the

sander if the work slips away. Make sure the material is large enough to be held safely. Do not try to sand any piece of material that you can't securely hold flat against the table

These machines obviously create a lot of dust. Make sure the dust collector is turned on.

Clean the abrasive regularly with crepe. **Do not use the sanders to remove glue or other substances; these will gum up the abrasive.** Remove excess glue before using the sander.

DISC AND DISC/BELT SANDER

These sanders can perform both aggressive and fine work depending on the grit of the sanding disc used and the pressure applied.

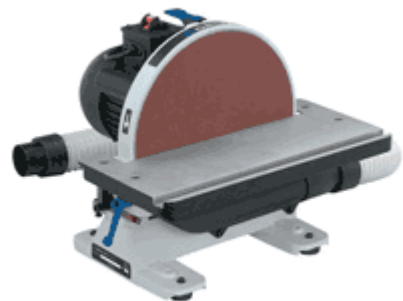
The disc/belt machine consists of a vertical disc sander and a vertical belt sander. They will do pretty similar things. The belt sander is capable of sanding surfaces up to 10" high and will give a finish with straight sanding marks. The disc sander although easier to control, results in curved sanding marks. Because the surface speed of the disc increases as you move toward the outer edge so to does the aggressiveness of the sanding.



Both parts of the machine can be altered to sand non 90° surfaces. Ask the technician for help if you need to do this.

The **disc-only sander** works the same as the disc part of the previous machine.

- Ensure areas around disc and belt are clear of tools. They both turn on together so be aware of conditions in both areas.
- Turn on dust collector. Turn on machine.
- Observe the direction of movement. Always use the area where the work will be pushed against the table (in the case of the disc) or the fence (in the case of the disc sander). **The disc sander travels counterclockwise so it is important to use only the left side of the table to sand. If work is pressed against the right side it can be lifted and thrown very rapidly.**
- Slowly advance material into the moving abrasive with gentle pressure. With contact move the material slowly from side to side in order to prevent heavy wear on one part of the belt and burning of the material due to heat build up.



EDGE SANDER

The Edge Sander is just a huge belt sander turned on its side with a table added to support the work. It will sand surfaces up to 6" x 37". The wheel at the end has an additional table so that it can be used as a spindle sander. (**Note:** Because the wheel must be tilted slightly to make the belt track properly, it will probably not be square to the table).



Caution: Because the belt is moving from left to right it will exert a considerable force towards the right.

- Ensure areas around the belt are clear of tools.
- Turn on dust collector. Turn on machine.
- Bring the surface to be sanded towards the belt ensuring they stay parallel. If at all possible slide the right edge of the object against the stop on the table, this will prevent it from being

pulled to the right.

- Don't press too hard against the belt. It will sand surprisingly fast. Because the belt moves from left to right, the left side needs less pressure than the right.

THICKNESS SANDER



planed.

The thickness sander works similarly to the thickness planer. The material is passed beneath a sanding drum on a conveyer belt. The height of the conveyer belt relative to the drum can be controlled by a crank as can its speed. The difference between the thickness sander and the thickness planer is the while the latter can be used to quickly and efficiently remove stock and "thickness" solid material the sander should be used primarily for creating a flat and smooth surface on the material. A typical use would be to finish a board that has resawn on the bandsaw to a thickness too thin to be thickness

This machine is relatively fragile and you should get a supervisor's assistance the first time you use it.

- Be sure the conveyer belt is clear of objects.
- Set the height of the drum so that it just touches the material.
- Make sure dust collector is on.
- Ask for assistance for setting conveyer speed. Feed material through the machine one piece at a time. Make sure it is flat as it is fed in and received at the other side.
- Do not decrease the thickness by more than ¼ turn between passes.

SPINDLE SANDER

The spindle sander uses an upright drum, which spins as well as oscillates vertically, to sand material. It is used mostly for curved pieces of wood and is most effective on inside curves. Drum sizes can be changed depending on the diameter and grit needed. This machine is not hooked up to a dust collector but has its own dust collecting bag that must be emptied periodically.



When changing drums, note that the bolt is reverse threaded. Also remember to select a red collar insert that fits the size of drum being used.

- Select proper drum and insert collar.
- Clear table of dust and other material.
- Turn on machine, noting rotating direction.
- Gently move work into drum, pushing against the direction of movement
- Keep material moving to prevent sanding scallops into work.

DRILL PRESS



There are 2 drill presses in the shop. They are used to drill holes in material at controlled angles and depth. Because of the bed or table to which material can be clamped, either directly or by way of a jig, multiple identical holes can be drilled.

The table can be adjusted up or down, as well as tilted. Drill bits are held in the chuck by means of 3 “jaws” which are tightened by turning a key. The bit is lowered into the material by rotating levers at the side of the machine. The depth of cut can be limited by means of a device located at the side of the machine just above the chuck. The 2 knurled nuts on the vertical threaded rod can be locked against each other to limit the movement of the drill. Ask the technician for guidance. Finally the speed at which the bit revolves can be adjusted by altering the pulley system. This is important – the wrong speed can damage the bit. Speed changes should also be done by the technician.

Preparation:

- Select the appropriate bit and fasten it into the chuck. If uncertain ask the technician for advice on drill speed. Make sure the bit is centered and tightly fastened.

- Both drill presses use keyless chucks. The chucks are tightened by simply turning the lower portion while holding the upper portion still. They are self-tightening under load but should be firmly tightened by hand.
- Clear table of debris and ensure that a piece of plywood is attached above it to protect it from being drilled into. (This will also result in a cleaner exit hole). Set the height of the table by means of the crank and clamping lever on the rear post.
- Make sure material is well secured to the table. For a large board, especially one being drilled with a small bit, holding tightly with the left hand will suffice. Otherwise or if in doubt use a clamp to hold the material. You can easily lose control of a small piece – the drill press is a lot stronger than you are.



Drilling:

- Slowly lower the bit into the material with the levers using your right hand. You may have to lift the bit out of the material once or several times to let waste clear from the flutes. When the bit is all the way down slowly raise it up again.
- Move material and repeat if necessary or turn off machine. Clean area when finished.

AIR PINNER / AIR STAPLER / AIR NOZZLE

The air pinner uses compressed air to drive wire brads (pins) of varying lengths into wood. It will leave only a very small hole and is an effective and fast way of fastening especially if used in conjunction with glue.



The stapler is similar but, of course, drives narrow staples. While these have greater holding power they have the disadvantage of being more visible.

The guns use special brads and staples. Limited numbers can be obtained from the technician. If your project will require a large number you should obtain your own.

The guns require 100 P.S.I. of air pressure to work. Ensure that the pressure is correct and that the air line valve is open.

Both guns should only be used with wood products. The pins in particular can easily deflect inside the wood and come out sideways and into an unsuspecting hand. Be sure your hand is far enough away that the fastener will not reach it in this event.

The air nozzle can be used to blow dust away. You should realize though that dust blown away by the air nozzle will just float in the air and land again. Any surface with a large amount of dust can be more effectively cleaned with a brush or a



vacuum. If using the nozzle to remove dust from your clothes, you must realize that forced air can be deadly. If air gets forced into your blood stream it can cause cardiac arrest. It can also puncture your ear drum. Keep nozzle away from your skin and do not spray your head.

HOT WIRE FOAM CUTTER

The hot wire cutter is used to make straight or curved cuts in polystyrene foam (Styrofoam). It cuts by melting the foam thus creating very smooth cut surfaces. However, polystyrene gives off toxic fumes when it's melted so it should be used only when the dust collector is turned on to create ventilation.

It is a lightly built device so care should be taken when using it. The wire which heats up and melts the foam can be easily broken. If this occurs ask the technician or monitor to replace it. Don't use excess force and make sure the correct heat setting is used.



- Before turning the tool on, make sure the wire is taut. If not, ask for help.
- Switch tool on.
- Adjust the temperature using the knob at the front right of the tool. Match the number on the knob with the thickness of the material shown in the table on the front left. Some experimentation may be required to find the best setting. For simple, straightforward cuts you can use a higher temperature, for complicated shapes a lower temperature. Temperatures which are too high will cause excess melting and fumes.
- The fence can either be used in a fixed position to make longer (rip) cuts or slid along the slots to make cross cuts.
- The top of the wire can be moved along the upper support to make angled cuts. Get help setting this up.