PORTABLE POWER TOOLS GUIDE

Safety Rules

1. Wear proper personal protection equipment (safety glasses, hearing protection, respiratory protection)
2. Remove loose clothing and jewelry before use. Tie long hair back before use.
3. Do not bypass any safety devices
4. Keep fingers clear of switches when moving or changing position with the tool
5. Ensure the tool has stopped moving before putting it down
6. Ensure the tool is off before plugging it in
7. Unplug the tool whenever changes to the tool are required
8. Do not carry the tools by the cord
9. Do not use the cord to unplug the tool
10. Be aware of the cord location while using the tools
11. Clamp workpiece firmly
12. If something is broken or breaks, notify one of the wood shop leads at (woodshop@sparkmakerspace.org).

Portable Power Tool Summary

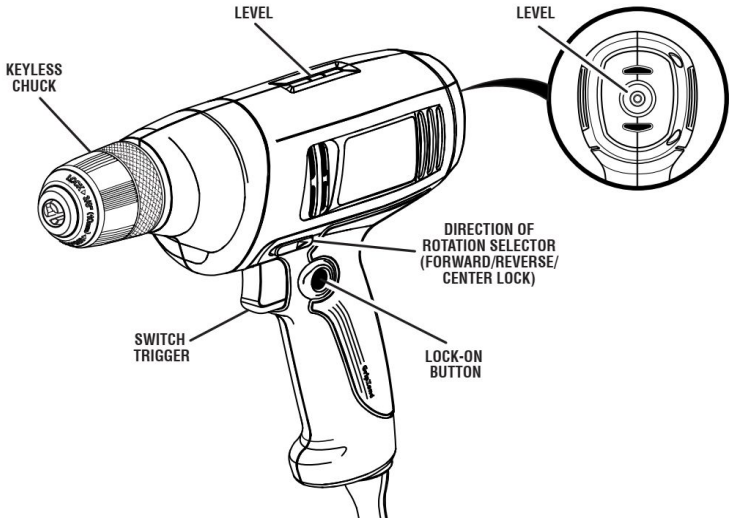
1. Tool Location in Shop
2. Uses for Tools
3. Drills
4. Jigsaw
5. Sanders
    a. Belt
    b. Oscillating
6. Grinder
7. Circular Saw
8. Routers
9. Biscuit Joiner
10. Power Planer
11. Oscillating Tool

Uses For Tools

Tool	Good for:	OK for:	Bad for:
Drills	- Making holes in wood or plastic	- Making holes in metal - Driving screws	
Belt Sander	- Aggressive sanding (wood, metal, plastic) - Large areas	- Removal of old finishes	- Finish sanding - Sanding lead-based paints
Oscillating Sander	- Finish sanding wood or metal	- Removal of old finishes	- Sanding lead-based paints - Aggressive sanding
Grinder	- Aggressive material removal in wood or metal, depending on wheel		- Sanding lead-based paints
Jigsaw	- Curved cuts in wood, metal, or plastic	- Straight cuts in wood, metal, or plastic	
Circular Saw	- Straight cuts in wood or plastics		- Metal, ceramics, composites, etc
Biscuit Joiner	- Joining two wooden parts together		- Anything other than lumber
Compact Router	- Light duty rounding of edges - Small slots - Inletting	- Freehand pockets - Large diameter holes (with appropriate fixture)	- Anything other than lumber
Full Size Router	- Rounding or chamfering of edges - Slotting - Pocketing	- Freehand carving - Large diameter holes (with appropriate fixture)	- Anything other than lumber

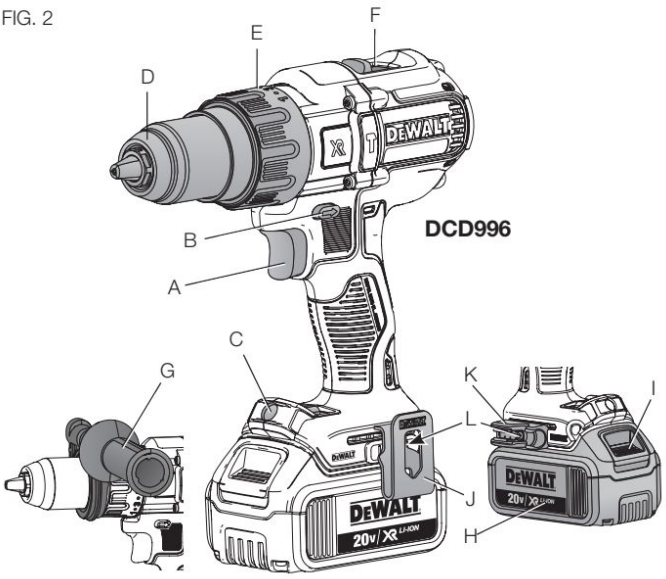
Power Drills

1. Safety:
    a. Wear personal protective equipment.
        i. Safety glasses
        ii. Hearing protection is recommended.
        iii. Tie long hair back.
    b. Keep finger clear of trigger until lined up for drilling
    c. Let the drill come to a complete stop before putting the tool down.
2. Drill Bits
    a. Portable tools have limited capacity. Only smaller bits (½" and below) should be used in portable power drills. Larger holes should be drilled on the drill press. If a hole saw or other large bit must be used with a portable drill, contact a Woodshop Lead for assistance.
3. Drill Parts:
    a. Diagram below shows basic parts of corded and cordless drills. Look and operation of parts may vary between manufacturers and models.



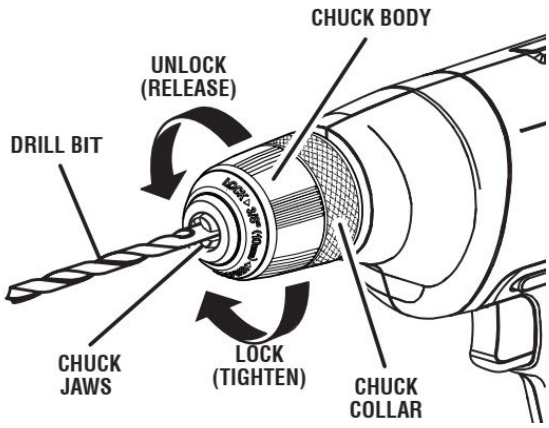
A. Trigger switch
B. Forward/reverse control button
C. Worklight
D. Chuck
E. Torque adjustment collar
F. Gear shifter
G. Side handle
H. Battery pack
I. Battery release button
J. Belt hook
K. Bit clip (Optional accessory)
L. Screw

FIG. 2



4. Operation:
    a. Mounting drill bits:
        i. Loosen chuck until the internal chuck fingers allow insertion of the drill bit.
        ii. Pointing the drill slightly upwards to allow the chuck to be tightened.

iii. Tighten chuck, keeping drill bit straight out of center of chuck.
iv. Removal is the reverse of installation.

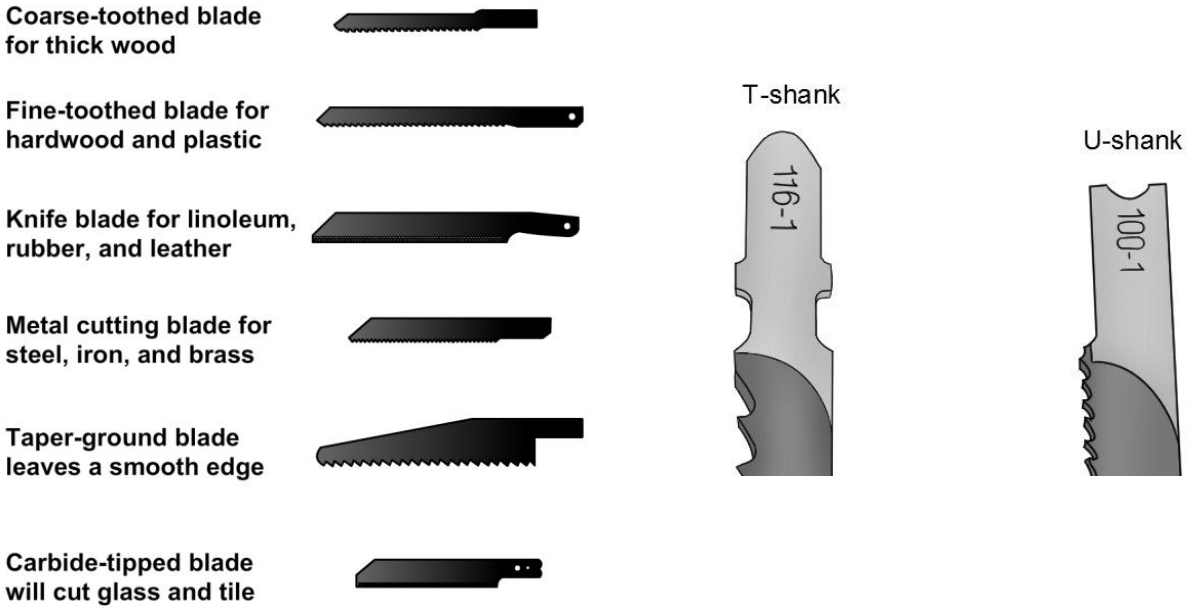


b. Alignment:
   i. Many modern drills have bubble levels built into them. By orienting the drill so that the bubble is centered between the lines of the level, it is possible to ensure the drill is plumb or level, depending on the orientation.
   ii. A center punch may be required to start in order to keep the drill bit from "walking" as the hole is started.
c. Trigger:
   i. Almost all drills will have a switch, toggle, or slide to change the direction of the drilling. This switch should only be moved when the drill is not moving and the trigger is not being pulled.
      1. Many drills will have a "locked" position midway between the forward and reverse position of the directional switch. This position may be used to help prevent accidental activation of the drill.
   ii. Most drills have variable speed trigger switches, which means that the further back the trigger switch is pulled, the faster the drill will go.
      1. Larger bits should be spun slower than larger bits.
      2. Drilling holes in metal should be done much slower than drilling holes in wood.
         a. Oil or other lubrication should be used when drilling metals.
   iii. Many drills have a button or latch to hold the trigger switch in the "on" position. This may be useful for extended drilling. However, care must be taken when using these latches, and the drill bit should be brought to a complete stop between holes.
   iv. When the hole is completed, keep the drill bit spinning as it is removed from the hole. This will reduce the chances of binding or breaking the bit.

5. After Use:
   a. Remove drill bit
      i. Return drill bit to correct storage location
   b. Wrap cord loosely
      i. Do not create tight bends or angles in the cord, to prevent damage to the conductor
   c. Return drill to correct location for next user

Jigsaw (or saber saw):

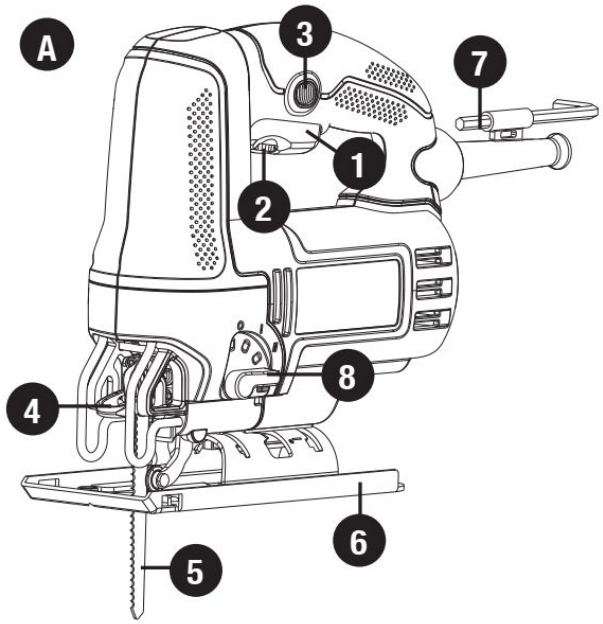
1. Safety:
    a. Wear personal protective equipment.
        i. Safety glasses
        ii. Hearing protection is recommended.
        iii. Tie long hair back.
        iv. Respiratory protection is recommended for extended use
    b. Clamp or anchor workpiece firmly
    c. Let the jigsaw come to a complete stop before putting the jigsaw down.
    d. Keep the electrical cord clear of the cutting area to prevent cord damage
2. Jigsaw Blades
    a. Jigsaw blades come in a variety of styles, depth, and tooth counts.



    b. Shank:
        i. Jigsaw blades may come with either a U or T shank. The current Spark saw uses T shank blades. The image above, from www.wonkeedonkeetools.co.uk, shows the difference.
    c. Teeth Per Inch (TPI):
        i. A large TPI value indicates a larger number of finer teeth. A lower TPI indicates a smaller number of larger teeth.
        ii. Coarser teeth will cut faster, but leave a coarser finish. Cutting wood will usually occur with a tooth count between 6 and 18 TPI.
    d. Blade depth
        i. Blade depth is the distance from the teeth to the spine of the blade. Shallower blades will turn corners more easily.
3. Jigsaw Parts:
    a. The figure below is from the manual for the Spark jigsaw, and contains the following parts.

FUNCTIONAL DESCRIPTION

1. Variable speed switch
2. Speed control dial
3. Lock-on button
4. Saw blade locking lever
5. Saw blade
6. Shoe
7. Wrench
8. Cutting action lever



i. Variable speed trigger switch - controls the speed of the saw. Pulling the trigger switch further results in higher saw speeds.
ii. Speed control dial - sets the maximum speed for the saw
iii. Lock-on button - latches the trigger switch in the “On” position. Potentially very dangerous, as releasing the trigger will not stop the saw.
iv. Saw blade locking lever - holds the saw blade into the saw holder.
v. Saw blade - the working portion of the saw. Do not lick this part, particularly when it is in motion.
vi. Shoe - the baseplate of the saw. The shoe is adjustable to cut beveled parts. The shoe should always be locked in place before using the saw. If bevel cuts are made, the shoe should be returned to the perpendicular at the end of use.
vii. Wrench (5mm) - used to loosen shoe for adjustment
viii. Cutting action lever - used to adjust the action of the saw on a scale from 0 to III. 0 is the smoothest cut, while III us the fastest. This lever should be returned to 0 at the end of use.

4. Jigsaw Shoe Adjustment and Blade Installation
    a. Shoe Adjustment:
        i. Ensure the saw is unplugged
        ii. Turn the saw upside down
        iii. Loosen the bolt holding the shoe in position using the hex wrench in the holder on the power cord
            1. If using the Dewalt jigsaws, no wrench is required - instead, loosen the clamping bar found between the body of the saw and the shoe

iv. Move the shoe towards the front of the saw to clear the angle stop teeth on the shoe
v. Adjust the shoe to the desired angle
vi. Move the shoe toward the back of the saw to lock the angle stop teeth.
vii. Tighten the bold holding the shoe in position
viii. Return the hex wrench to its holder
ix. When the cutting operation is completed, return the shoe to the position perpendicular to the blade

b. Blade Installation:
i. Ensure the saw is unplugged
ii. Push the saw blade locking lever upward.
iii. With teeth facing forward, insert the shank of the saw blade into the blade holder as far as it will go.
iv. Release the lever.
v. Check the blade is secure before cutting

5. Jigsaw Operation:
a. Hold the workpiece firmly with clamps or other retainment methods.
b. Clearly mark the intended cut path
c. Holding the jigsaw blade clear of the workpiece, line up the blade with one end of the cut mark
i. If the cut is entirely contained within the workpiece, a hole may be drilled to allow access for the blade
d. Pull the trigger switch to start the blade. The further the trigger is pulled, the faster the blade will move, up to the limit set by the speed control dial.
e. Once the blade is moving at the desired speed, follow the cut lines to completion.
f. The cutting radius of the saw is dependent on the blade installed. If the saw starts to slow down or bog during a turn, the turn is too tight for the saw. Back up in the cut, and try again using a larger radius.
g. Let the blade come to a complete stop before putting the saw down.
6. After Use:
a. Clean all dust from the jigsaw using brush or vacuum.
b. Remove the blade from the saw, and return the blade to the correct storage location.
c. Set the shoe back to zero degrees
d. Set the cutting action lever back to zero
e. Loosely wrap the cord around the jigsaw
i. Do not create tight bends or angles in the cord, to prevent damage to the internal cable conductors
f. Return the jigsaw to the correct location for the next user

Belt Sander

1. Safety:
    a. Wear personal protective equipment.
        i. Safety glasses
        ii. Hearing protection is recommended.
        iii. Tie long hair back.
        iv. Respiratory protection is recommended for extended use
    b. Moving belts can cause significant lacerations. Care should be taken to avoid contact with the belt while operating the sander.
        i. Tracking should be checked before each use.
    c. Keep a firm grip on the sander during operation
    d. Clamp or anchor workpiece firmly
    e. Let the sander come to a complete stop before putting the sander down.
    f. Keep the electrical cord clear of the area being sanded to prevent accidental contact
2. Abrasive Belts:
    a. The belt sander uses a flexible abrasive belt. The belts are available in a wide range of sanding grits, where a high number indicates a finer (smoother) belt.
    b. The following table may be used for guidance on choosing belt abrasive grits for various applications:

Abrasive (grit)	***Application***
36 to 60	Rough, fast stock removal; removal of old finishes
60 to 100	Stock removal, surface preparation for painting
120 to 180	Wood finishing
200 or greater	Fine finishing, especially on hard woods

3. Belt Sander parts (not all machines will have all parts; locations vary by model)
    a. Belt tension lever - used to release pressure from the abrasive belt to allow replacement of the belt.
    b. Belt alignment (tracking) adjustment - a knob used to adjust the alignment of the belt rollers to ensure the belt remains centered on the rollers during use
    c. Platten - the hard, smooth, flat surface against which the belt runs on the working surface of the machine
    d. Trigger switch - switch use to control power to the sander
    e. Trigger lock button - latch used to lock the sander in the powered position
        i. The trigger lock button should be used with extreme care. The sander will remain running without any further interaction with the user, which can be dangerous without proper attention.

ii. To use: pull the trigger to power on the sander, then press the trigger lock button. The sander will remain running until the trigger is squeezed again and released.

f. Speed selection dial - Used to adjust running speed of the sander. Adjustment should not be made while the sander is running.
g. Forward handle - used to increase user control over the sander
h. Dust extraction outlet - exit for the dust extraction system within the sander. Ideally, this should be connected to a vacuum or dust bag
i. Dust bag - Collection point for sanding dust. Should be emptied after each use of the sander.

4. Belt Replacement and Tracking Adjustment:
    a. Belt Replacement:
        i. Ensure power is disconnected from the sander
        ii. Toggle the belt tension lever to move the idle roller closer to the drive roller
        iii. Remove the old belt (if installed)
        iv. Identify the direction of rotation on the new belt. This is usually indicated by an arrow printed on the interior of the belt. If no arrow is present, the belt is bidirectional and may be installed in either orientation.
            1. When the sander is upright on a flat surface, the bottom working surface of the belt will move towards the user, pulling the sander away from the user. If the belt is directional, it should be installed so the arrow points in the direction of rotation.
        v. Install the belt so that it is centered on both rollers
        vi. Return the belt tension lever to the original closed position.
        vii. Adjust the belt tracking (below).
    b. Belt Tracking Adjustment:
        i. Turn sander upside down and plug it into the power source
        ii. Hold the sander firmly with one hand, engage trigger switch to turn the sander “ON”, and note the tracking of the sanding belt
            1. The ideal belt tracking will keep the belt centered on the both rollers, and the platten.
            2. Do not allow the belt to contact the frame of the sander.
            3. Belts extending off the roller are a laceration hazard; the belt should be tuned to run centered for safety
        iii. Adjust belt tracking by turning the belt adjustment knob until the belt runs smooth in the center of the rollers.
        iv. Belt tracking should be checked after several minutes of operation, and regularly during use.
5. Operation:
    a. Ensure the workpiece is held firmly in place, through clamps or other retention methods.

b. The sander will be used in a forward and backward motion, usually parallel to the grain of the surface being sanded. The user should be in a position to comfortably work with the sander.
c. Keep a firm grip on both handles of the sander.
d. With the sander belt off the work, start the sander by depressing the trigger switch.
e. Place the “heel” of the sander on the workpiece, and start moving the sander forward while lowering the sander onto the workpiece.
f. Keep the sander moving in back and forth strokes to keep sanding even, and prevent gouging.
    i. No downward pressure is required. The weight of the sander should be doing the work.
g. When sanding is complete, lift the sander from the workpiece before releasing the trigger switch to stop the sander.

6. After Use:
    a. Clean all dust from the sander using brush or vacuum.
    b. Empty the dust collection bag, if present.
    c. Loosely wrap the cord around the sander handles
        i. Do not create tight bends or angles in the cord, to prevent damage to the internal cable conductors
    d. Return the sander to the correct location for the next user

Oscillating Sanders

1. Safety:
    a. Wear personal protective equipment.
        i. Safety glasses
        ii. Hearing protection is recommended.
        iii. Tie long hair back.
        iv. Respiratory protection is recommended for extended use
    b. Keep a firm grip on the sander during operation
    c. Clamp or anchor workpiece firmly
    d. Let the sander come to a complete stop before putting the sander down.
    e. Keep the electrical cord clear of the area being sanded to prevent accidental contact
2. Types of Sanders
    a. Several types of oscillation sanders are available, categorized by type of oscillation, pad size, and pad shape.
    b. Oscillation may be linear, orbital, or random-orbital.
        i. Linear sanders move the sanding surface in a back-and-forth linear motion. This is commonly found in older sanders.
            1. Linear sanders should be used parallel to the wood grain direction, to prevent gouging or marking of the work surface
        ii. Orbital sanders move the sanding surface in a series of small circles,
            1. Orbital sanders are less sensitive to grain direction, but may leave small swirls in the work surface
        iii. Random orbital sanders move the sanding surface in an erratic series of ellipses.
            1. Random orbital sanders are least sensitive to grain direction
    c. Pad size and Shape
        i. Square:
            1. Usually referred to as a “quarter sheet sander” because it uses one-quarter of a standard sheet of sandpaper.
            2. Usually orbital
        ii. Retangular:
            1. Either a half or third sheet sander, as it uses a half or a third of a standard sheet of sandpaper
            2. Usually orbital or linear
        iii. Round:
            1. Often 5-inch, but sizes may vary
            2. Usually random orbital
            3. Require sandpaper specific to the diameter, attachment method, and hold pattern for use
        iv. Others:
            1. Other sizes and shapes are available for specific applications. Triangular pads are common for corner applications.

d. Sanding Grits
    i. The chart below is taken from the manual of a Bosch quarter-sheet sander.

	Applications	Grit
Wood	For preliminary sanding of rough wood, unplaned boards.	Coarse 40, 60
	For mid-stage sanding and smoothing of small irregularities.	Medium 80, 100, 120
	For finish and fine sanding speed and sanding sheet (sandpaper).	Fine 180, 240, 320, 400
Paint/enamels and primers, and fillers	For removing paint.	Coarse 40, 60
	For sanding primer.	Medium 80, 100, 120
	For final sanding of primers between coats.	Fine 180, 240, 320

    ii. If the surface is rough, start sanding with a coarse grit, then medium, and then finish with a fine or extra-fine grit. The required process will vary with different workpieces.
        1. Continue sanding with each grit stage until all scratches from previous grits are no longer visible

3. Sander Parts: (varies by sander age, manufacturer, and model)
    a. Sanding Pad - foam pad mounted on the bottom of the sander
    b. Sandpaper clamps - mounted on each end of partial sheet sanders (¼, ⅓, or ½ sheet) to hold sandpaper; may be of several styles.
    c. Switch - power switch to turn sander on and off.
    d. Oscillation switch - found on older sanders capable of linear or oscillating operation; used to switch between operating modes
    e. Dust extraction port - exit of sander dust collection system. Should be fed into a dust bag or vacuum system. May not be present on all models
    f. Dust collection bag - collector for dust extraction port
4. Sandpaper Installation:
    a. Ensure power to the sander is disconnected
    b. For round sanders:
        i. Attach the sandpaper using either pressure sensitive adhesive (PSA) self-stick sheets, or hook-and-loop sheets, as appropriate.
            1. PSA sanders will have a mostly smooth sanding pad bottom.
                a. PSA sandpaper should be removed immediately after use. The sanding process warms the adhesive, and when it

cools it will solidify and cannot be removed without damage to the sanding pad. If the sander has PSA sanding sheets attached which must be removed, run the sander against a scrap piece of lumber for several minutes to soften the adhesive before removal.

2. Hook and loop sanders will have a fuzzy sanding pad bottom
3. Holes in the sandpaper should be lined up, as much as possible, with the holes in the sander pad. This allows the dust extraction system to function properly.

c. For partial sheet sanders:
    i. Divide a standard sheet of sandpaper into the correct size, using a sharp table or scrap edge as a guide.
        1. Do not use scissors, as the abrasive sheet will damage the cutting edges.
    ii. Remove the old sandpaper by releasing the clamp on each end.
        1. Wire clamps:
            a. The loop of each wire clamp arm should be lifted up past the clamp retaining post, then pulled horizontally out and away from the sander body.
            b. Move the loop down past the sanding pad until all pressure is off the clamp
        2. Spring clamps:
            a. Lift and hold the tab to release the clamp. In some sanders, it may be necessary to first slide the dust evacuation shroud out of the way.
    iii. Clamp the new sandpaper in one end of the sander.
        1. Wire clamps:
            a. Set the end of the sandpaper under the clamp
            b. Holding the sandpaper in place, lift the loop on the arm of the appropriate clamp until it is above the clamp retaining post.
            c. Swivel the clamp arm loop until it is in its original position alongside the sander body.
            d. Gently tug the sandpaper to ensure it is held firmly.
    iv. Pull the paper taut, fold it over the sanding pad with the abrasive out, and clamp the other end.

5. Sander Operation
    a. Secure the workpiece firmly, using clamps or other retainment methods
    b. Before turning the sander on, place the sander on the workpiece
    c. Turn sander on
    d. Allow the weight of the sander to do the work; excessive force on the sander is counterproductive

e. Continually move the sander, sweeping the sander in overlapping strokes along the grain of the workpiece
f. When the work is completed, remove the sander from the workpiece before shutting it off.
g. Ensure the sander has stopped moving before putting it down.

6. After Use:
    a. Clean all dust from the sander using brush or vacuum.
    b. Empty the dust collection bag, if present.
    c. Loosely wrap the cord around the sander handles
        i. Do not create tight bends or angles in the cord, to prevent damage to the internal cable conductors
    d. Return the sander to the correct location for the next user

Grinder/Disc Sander:

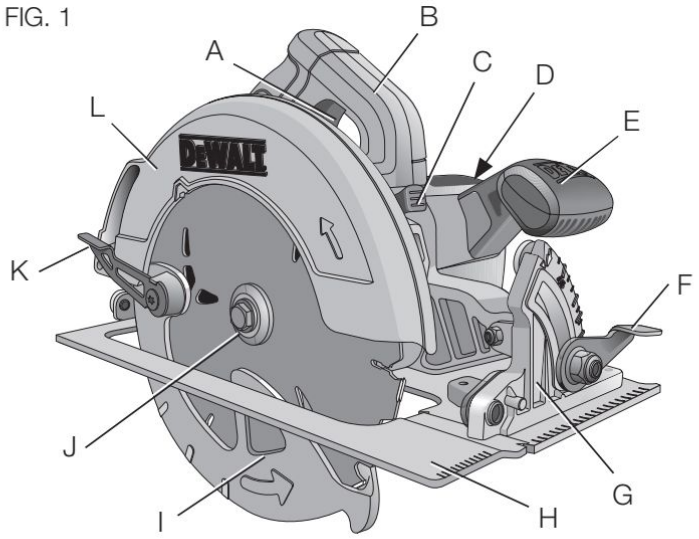
The SPARK grinder is currently missing important parts, including a safety guard. These instructions will be updated when the grinder is back in service.

Portable Circular Saw:

A. Safety
    a. Wear personal protective equipment.
        i. Safety glasses
        ii. Hearing protection is recommended.
        iii. Tie long hair back.
        iv. Respiratory protection is recommended for extended use
    b. Do not bypass safety guards on the circular saw
    c. Clamp or anchor workpiece firmly
    d. Be aware of what is under the workpiece
    e. Let the circular saw come to complete stop before putting the saw down
    f. Only cut wood or engineered lumber (plywood, MDF, particle board, etc) with the circular saw. Do not cut plastics, metals, ceramics, or any other materials.
    g. Keep the electrical cord clear of the cutting area to prevent cord damage
    h. Do not attempt plunge cuts with the portable circular saw. If you must make a plunge cut, contact a Woodshop Lead for permission and assistance before proceeding
B. Kickback Prevention:
    a. Kickback occurs when the saw blade hits a sudden increase in resistance while cutting.
        i. Increased resistance may be due to knots, inclusions, or foreign material in the wood.
        ii. Increased resistance may also be due to a pinched, bound, or misaligned blade.
    b. The sudden increase in resistance results in the blade forcing the saw back towards the user, often in a sudden and startling fashion. This can also throw the workpiece if it is not properly restrained.
    c. Kickback may be prevented by:
        i. Starting the saw with the teeth clear of the workpiece
        ii. Inspecting the workpiece for knots, inclusions, or foreign material before starting the cut
        iii. Ensuring the workpiece is properly restrained before cutting operations start
        iv. Keeping blade depth to the minimum required for the cut
        v. Using a sharp saw blade
    d. Should kickback occur, release the saw trigger switch and let the blade come to a complete halt before correcting the situation which caused the kickback
    e. If the correction is not obvious, or there are any questions regarding safe operation, get help from a Woodshop Lead.
C. Circular Saw blades
    a. Saw blades come in a number of sizes and tooth counts, depending on saw and application

b. Blades should be mounted on the saw so that the bottom of the blades rotates forward (see arrow on diagram below for direction of rotation).
c. Saw blade sizes range from 3-½ inches to 10 inches. The most common size for corded portable saws is 7-½ inch or 8-¼ inch. The lighter Spark saw (size drive) uses 7-½ inch blades; the heavier saw (worm drive) uses 8-¼ inch blades.
d. Blades for coarser cuts have fewer teeth; blades for finer finishing have more teeth.

FIG. 1



COMPONENTS (Fig. 1)

⚠ ***WARNING:*** *Never modify the power tool or any part of it. Damage or personal injury could result.*

A. Trigger switch
B. Main handle
C. Blade lock
D. End cap
E. Auxiliary handle
F. Bevel adjustment lever
G. Bevel angle adjustment mechanism
H. Foot plate
I. Lower blade guard
J. Blade clamping screw
K. Lower guard lever
L. Upper blade guard

D. Circular Saw Parts (figure taken from the Canadian Centre for Occupational Health and Safety; parts will vary in location and style on different makes and models)
   a. Trigger switch - turns saw on. Releasing trigger switch will cut power to the saw motor; however, blade will not stop immediately
   b. Main handle - not to be confused with a Maine handle; this one's in Connecticut.
   c. Blade arbor lock - used to prevent rotation of the blade arbor when changing saw blades
   d. Motor housing end cap - contains the electric motor to drive the saw
   e. Front/Auxiliary handle - used to help guide the saw during cutting

f. Bevel adjustment lock lever - this lever may be loosened to allow the bevel angle to be adjusted, by changing the angle between the shoe and the saw blade. The lever must be tightened completely after adjustment and before cutting
g. Bevel adjustment gauge and assembly - adjusted by loosening the bevel adjustment lever (f).
h. Foot (also base or shoe) plate: flat plate which the saw rides on during operation. It is usually adjustable for depth and angle (bevel). The plate usually has a notch in the front to indicate the path of blade travel; one side is for the for the blade at 0", and the other one for the blade at 45"
i. Lower blade guard - a retracting guard that covers the lower half of the saw blade. This blade uncovers the lower half of the blade as the cut progresses. This part must return to the starting position before the saw is laid down.
j. Blade clamp screw - holds the blade to the saw spindle. Loosened with blade wrench
k. Lower blade guard lever - used to move lower blade guard, if required.
l. Upper blade guard (not labeled on diagram) - a fixed safety cover for the top half of the saw blade
m. Depth adjustment lock lever (not shown on diagram) - this knob may be loosened to allow the depth of cut to be adjusted, by exposing more or less of the blade. The knob must be tightened completely after adjustment and before cutting
n. Blade wrench (not shown on diagram) - wrench used to change saw blades

E. Operation:
   a. Angle adjustment:
      i. The angle of the blade may be adjusted by loosening the bevel adjustment knob or lever, and moving the shoe until the correct blade angle is reached.
      ii. The angle adjustment knob or lever should then be tightened completely to prevent movement during the cut
   b. Depth Adjustment:
      i. The depth of the blade may be adjusted by loosening the depth adjustment knob or lever, and moving the shoe until the correct blade depth is reached.
      ii. The saw blade should extend approximately one tooth length through the workpiece.
      iii. The depth adjustment knob or lever should then be tightened completely to prevent movement during the cut
   c. Line Guide:
      i. The notch in the front of the shoe is normally labeled; one side for the blade at 0 degrees, and the other side for the blade at 45 degrees.
      ii. The line guide may or may not be accurate, depending on the saw, blade, and shoe combination.
   d. Cuts:
      i. The blade should be started with all blade teeth clear of the workpiece

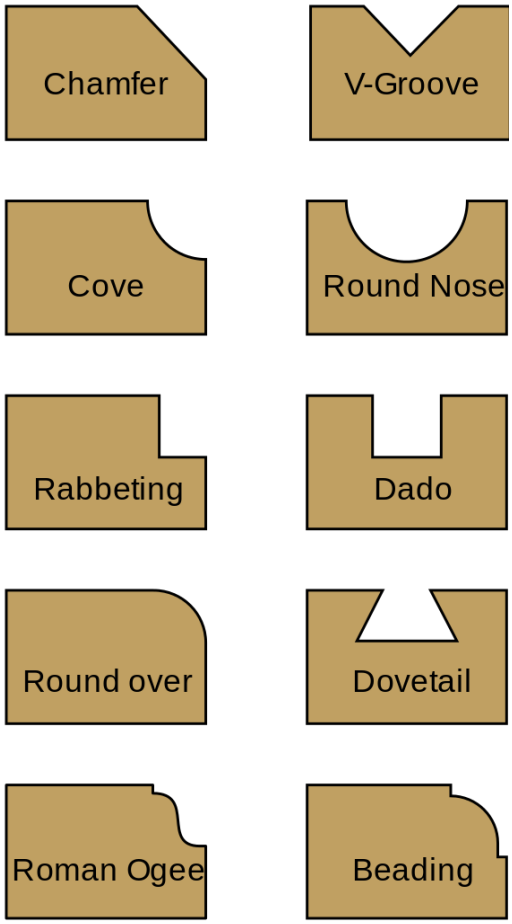
ii. The saw should be firmly grasped on both main and forward handles when the blade is started. The torque of spinning blade up may cause the saw to twist
    1. Ensure the hand position does not restrict the movement of the lower blade guard
iii. Squeeze the trigger switch to start the saw. The trigger switch has only two positions -- on and off. Do not stop and start the blade in the middle of a cut
iv. Make the cut using light and continuous pressure. Do not force the saw.
v. After the cut, release the trigger switch. Be aware that the saw will continue to rotate, and be dangerous, for some time after the trigger switch is released. Maintain control of the saw until the blade comes to a complete stop.
vi. Ensure the lower blade guard returns to the fully-covered position before putting the saw down

F. After use:
    a. Clean all dust from the circular saw using brush or vacuum.
    b. Set the bevel angle back to zero degrees
    c. Set the cutting depth back to zero
    d. Loosely wrap the cord around the saw
        i. Do not create tight bends or angles in the cord, to prevent damage to the internal cable conductors
    e. Return the saw to the correct location for the next user

Routers:

1. Safety:
    a. Wear personal protective equipment.
        i. Safety glasses
        ii. Hearing protection is recommended.
        iii. Tie long hair back.
        iv. Respiratory protection is recommended for extended use
    b. Keep a firm grip on the router during operation
    c. Clamp or anchor workpiece firmly
    d. Let the router come to a complete stop before putting the sander down.
    e. Keep the electrical cord clear of the area being sanded to prevent accidental contact
2. Router Types:
    a. Routers come in four base styles, and two size classes
    b. Bases:
        i. Fixed base - simplest portable type. The base is set at the desired cut depth, and remains fixed in place during cutting operations. The workpiece is fixed, and the router is controlled by the user
        ii. Plunge base - allows vertical movement of a portable router, to allow plunge cuts (in the center of parts). Maximum cut depth is set on the base before use. Similar to the fixed base, the workpiece is fixed, and the router is controlled by the user.
        iii. Table - The router is fixed on the underside of the router table, so the cutting bit protrudes upwards from the table surface. Unlike the fixed or plunge bases, the router is fixed and the workpiece controlled by the user. The router table allows the use of fences and other jigs for consistent work
        iv. CNC - A computer controlled gantry controls the motion of the router over a fixed workpiece. The SPARK CNC router is covered under separate instructions.
    c. Router Sizes
        i. Routers fall into two size categories: full size and compact
        ii. Full size routers are often rated to 1.5 HP or greater. They will accept router bits with a shank size up to 1/2-inch. They are commonly used in fixed or plunge bases, and router tables.
        iii. Compact (trim, palm, etc) routers are generally rated up to 1 hp. They will accept router bits with a shank size up to 1/4-inch. They are commonly used in fixed or plunge bases, and small CNC machines (like the one at SPARK).
3. Router Bits
    a. Router bits are available in a truly mind-boggling number of sizes and profiles. The most commonly used varieties are shown in the diagram below, borrowed from Wikipedia.

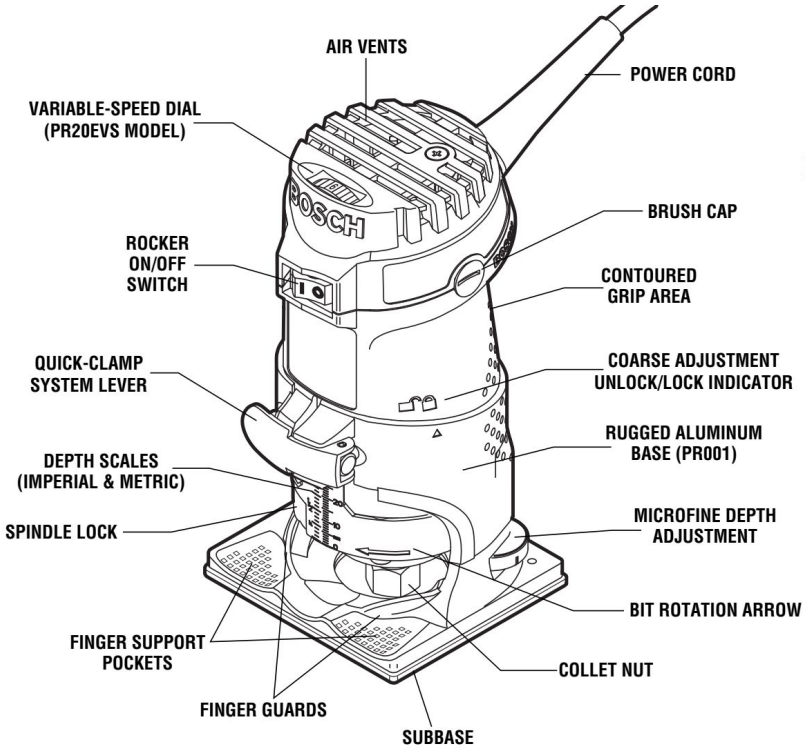
b. Bit shanks in the US will be either 1/4 or 1/2 inch.
c. Some bits will include a guide bearing, either at the top or bottom of the bit. This will allow them to follow an existing contour in the wood. This also allows the use of templates for repeated patterns.
d. Router bits may be either solid high speed steel (HSS), or a steel body with carbide cutting edges. Generally, the carbide bits will remain sharper longer, but will cost more to purchase.
e. Multi-piece bits are used for more complex geometries. These bits have an arbor shaft, which mounts several smaller cutters, spacers, and bearings stacked together to get the required profile.
f. Bits for portable (fixed base and plunge) routers should be at least 1/4-inch smaller than the opening in the router base, to prevent contact between the bit and the base during operation.

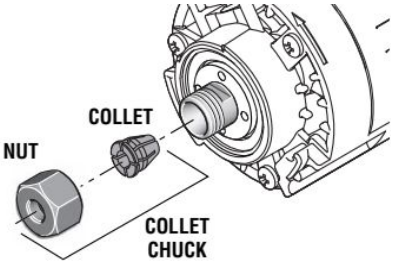


g. Larger bits, generally above 1-inch outside diameter, should only be used on the router table, as they are too large to safely be controlled by hand.
h. The SPARK woodshop has a small selection of commonly used router bits. If a member has a particular project which requires a specific bit, they will likely have to supply it themselves. However, talk to your friendly Woodshop Lead to discuss options.

4. Router Parts: (SPARK palm router shown; parts and locations will vary by make and model)
   a. Power switch - turns router on and off
   b. Variable speed dial (not present on all tools) - allows adjustment of router rotation speed. Larger diameter bits should be spuns at lower speeds than smaller bits
   c. Depth lock (“quick-clamp system lever”) - when released, allows adjustment of the depth of cut for the router. Must be locked before cutting
   d. Fine adjustment wheel (not present on all tools) - allows fine adjustment of the cut depth of the router. Depth lock must be unlocked prior to adjustment, and should be locked before cutting
   e. Base - fixed base, usually metal. Allows depth adjustment of the router

f. Sub-base - plastic cover for base to protect the workpiece. May be removed to mount base to fixtures
g. Spindle lock - locks spindle to prevent rotation. Only used when changing bits
h. Collet chuck - made of two parts, collet and collet nut. The collet is a segmented ring, used to evenly and firmly grip the shaft of a router bit. It should remain mounted in the collet nut at all times. Loosening the collet nut relieves pressure on the collet, allowing installation or removal of the cutting bit.



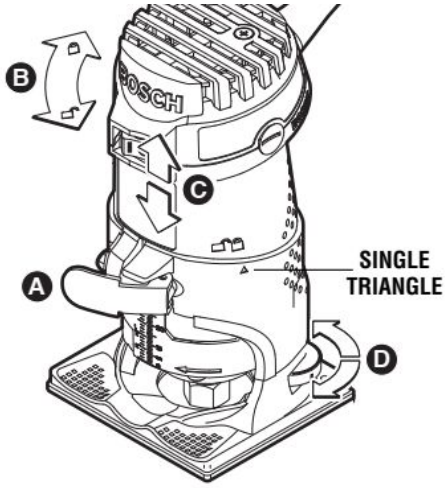


5. Router Bit Installation and Removal
    a. Unplug router
    b. If the router has recently been used, ensure the cutter, collet nut, and collet have cooled enough to touch
    c. Place the router on its side or back
    d. Press in the spindle lock gently, and turn the spindle until the lock engages. The spindle will no longer rotate
    e. Holding the spindle lock engaged, use the appropriate sized wrench to loosen the collet nut
    f. One the nut is loosened, back the nut off until the collet relaxes enough to allow removal or insertion of the router bit.
        i. If the collet chuck it loosened enough to come off the router, ensure the collet nut is firmly mounted before remounting the collet chuck.
        ii. For some older routers, it may be necessary to tap the router bit with a plastic mallet or piece of scrap wood to break the collet loose once the nut

is loosened. Use of a metal hammer will damage the bit, and should be avoided.

g. Insert the shank of the router bit into the collet chuck as far as it will go, then back out until the cutters are 1/8 to 1/4 inch from the collet nut face
    i. For safety, at least 5/8-inch of shank must remain in the collet at all times
    ii. The cutter diameter must be at least 1/4-inch smaller than the opening in the router base, to prevent accidental contact between the bit and the shoe.
h. With the spindle lock engaged, tighten the collet nut firmly
    i. To prevent damage to the collet chuck, do not tighten the collet nut without a bit installed.

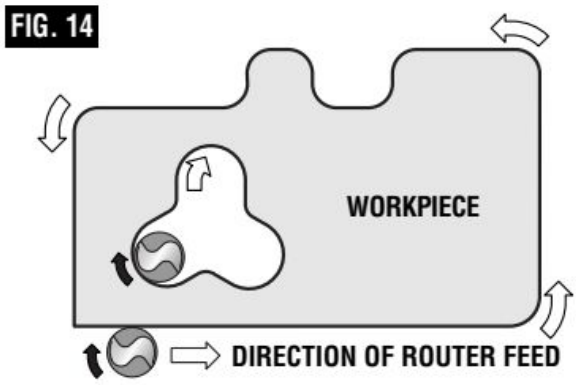
6. Setting Router Depth
    a. Deep cuts with a router should be done in several stages. Depth of cut will depend on router bit and router power, but single pass depths should not exceed 1/8-inch maximum.
    b. Open the clamping lever, or equivalent, to loosen the base from the router.
        i. In the case of the small Bosch router, turn the motor sideways (B) until the small arrow points to the “Unlock” symbol after loosening the clamp lever (A).



    c. Slide the router up and down in the base.
        i. In the case of the table router, the large midbody ring should be turned to adjust the depth of cut.
    d. Some routers will have a knob or wheel for fine adjustment of the depth of cut.
        i. In the case of the small Bosch router, the body should be turned sideways until the arrow points to the “Lock” symbol, then the fine adjustment wheel (D) should be used for final adjustment.
    e. Close the clamping lever, or equivalent, to lock the router and base into position.
7. Router Operation
    a. Ensure the workpiece is firmly mounted, using clamps or other retention method.
    b. The router should be held firmly, away from the workpiece, when being started. A significant twisting will occur as the motor spins up.
    c. The router should be firmly held with both hands during all cutting operations.
    d. The router should be given time to reach full speed before cutting is started.
    e. Router feed rates:
        i. Feed rates will take practice to perfect. The ideal feed rate should result in the continuous production of uniform wood chips - not intermittent production of very large chips, or the continuous production of sawdust.

ii. The router should be moved steadily and smoothly. Pay attention to the sound of the machine as it works.
iii. Softer woods will require a faster feed rate than harder woods.
iv. Larger bits or deeper cuts will require a slower feed rate than smaller bits and shallow cuts.
v. Cutting parallel to the grain usually requires a faster feed that cutting perpendicular to it
vi. Feeding the router too fast will result in the spindle slowing down as the router attempts to take a larger than normal chunk out of the wood with each revolution. This can result in “tearout” - roughly removed splintery chunks at the edge of the cut
vii. Feeding the router too slowly will result in the router scraping the workpiece rather than cutting it, resulting in sawdust-like waste. Scraping produces significant heat which can mar or burn the workpiece, and in extreme cases damage the cutter.
    1. Slow feeding also increases the tendency of the router to bounce off the sides of the cut, resulting in scalloped edges

f. Feed direction:
    i. The cutting edge on the router should “scoop” the material out of the workpiece ahead of the router. The diagram, Fig 14 from the Bosch router manual, shows the correct feed direction for both internal and external work.



g. Router guiding:
    i. The router can be used freehand, mounted in a jig (such as the router table), or can use external fixturing for guidance.
        1. External fixtures can include pre-cut templates, finger-joint or dovetail jigs, or something as simple as a scrap lumber clamped to a workpiece as a guide.
    ii. Some bits have either a pilot, or a pilot bearing. These bits can be used to make the router follow an existing edge of the workpiece, commonly used to round over or chamfer work.
        1. If pilot bearings on a bit do not spin freely, the bearing must be replaced. Contact a Woodshop Lead for assistance.
h. Ensure the router has come to a complete stop before putting it down.

8. After use:
    a. Clean all dust from the router using brush or vacuum.
    b. Portable tools:

i. Remove the cutting bit
    1. DO NOT TIGHTEN THE EMPTY COLLET CHUCK
ii. Set the router depth as deep as possible to make the overall size as small as possible
iii. Replace the router in its case, if available
iv. If no case is available, loosely wrap the cord around the router
    1. Do not create tight bends or angles in the cord, to prevent damage to the internal cable conductors
v. Return the router to the correct location for the next user

c. Table router:
    i. Place a piloted round-over bit in the router
    ii. Set the depth as close as possible to the correct depth for the round over bit

There are several other tools available for special uses at SPARK. As they are in special use, SPARK Safety and Instruction Manuals have not yet been made. If you think you have a need for one of these tools in a project, please contact the Woodshop Leads for one-on-one instruction on the tool. The specialty tools are:

Biscuit Joiner - used to attach boards along their narrow edges to make wider stock

Power Plane - a motorized version of a traditional woodworkers plane, used to level or thin boards

Oscillating Tool - used to make flush cuts or do light sanding in corners.