Hand-Held Power Tools

Part One
The safe operation of the circular saw, reciprocating saw, and jigsaw.

Part Two
Safety and power requirements; using drills, routers, and sanders.

Program Summary:
These videos illustrate and explain the various hand-held power tools one would find in a typical school workshop. Their segmented style allows for the full explanation of one tool before moving on to another. This also allows the shop teacher to use only a segment at a time, if desired, to illustrate one specific tool. The power tools shown in these videos include circular saws, reciprocating saws, jigsaws, drills, screwdrivers, hammer drills, routers, and sanders. The videos include a special section on safety with emphasis on power extension cords (illustrating the appropriate gauge of cable for different uses) and the hazards of dangerous noise levels. As well, proper safety procedures are followed during the operation of each tool. Care is taken to include different applications, such as the use of jigs and the benefits of various blades. These videos are an excellent introduction or review for any school workshop.

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Safety:
By their very nature, handheld power tools can be very dangerous and these videos address safety issues as they apply to each tool. Nevertheless, these videos must not be used as a substitution for teacher demonstrations of safe operation. Some form of testing and evaluating the student for knowledge of safety issues should be used prior to students handling power tools. The decision as to whether a student is ready to use any hand-held power tool must remain with the teacher.

Safety begins before the tools are even plugged in. Keeping the workshop clean and organized contributes greatly to a safe working environment.

It’s important for the teacher to read and understand fully the manufacturers’ user manuals before beginning to demonstrate or use power tools. Only when the instructor is competent can students be properly trained.
Lead by example. It’s no use asking students to follow safety rules and wear appropriate clothing if the teacher doesn’t. Safety guards must be adjusted properly and used whenever possible. When power tools leave the workshop, a control and sign-out system should be in place. All portable electric tools that are damaged should be removed from use, tagged “Do Not Use”, and locked away until they can be sent for servicing.

Noise Protection:
Protection from hearing loss is an important aspect of using power tools, but remember that in terms of dangerous levels, it’s not just how loud a tool is that makes it harmful, it’s also the duration of the noise. The following graph shows the different levels of noise that are generated by different power tools.

Prolonged exposure to any noise above 90dBs (decibels) can cause gradual hearing loss. The decibel scale is logarithmic: 100dBs is 10 times louder than 90dBs. For every 3dBs above 85dBs the permissible exposure time is cut in half. By the time the level reaches 100dBs, hearing damage can happen after 15 minutes. At 110dBs it’s less than 2 minutes. So what tool is the most ear damaging? It’s the belt sander because even though it’s not the loudest, it is often used for the longest period of time. Here’s another reason to keep your tools well maintained: by using sharp saw blades you can reduce the noise by as much as 5dB. And it’s not just individual tools that you need to take precautions for… the average noise level in a busy wood shop is 100dBs.

Extension Cords:
Extension cords are often taken for granted by students and teachers. Cords that are coiled, for instance, don’t dissipate heat well. This can create a fire hazard when under heavy electrical loads. To avoid this potential build up of heat, always unwind the full cord when in use. If using an extension cord on a reel, the entire cord should be unwound when in use and not left on the reel. The appropriate cord should be used when working outdoors.

When choosing a cord, the most important factors to consider are wire diameter (gauge) and length… the larger a wire’s diameter, the smaller the gauge number. A wire with a small diameter (like 16 or 18 gauge) can’t carry as much power as a wire with a larger diameter (10 or 12 gauge); the smaller wire has greater resistance. Using a cord with too small a diameter could damage your tools or even start a fire.

An extension cord that’s too long can create a type of resistance known as voltage drop, which gets worse as the cord’s length gets longer. As the electricity travels farther from the source, its energy diminishes. The voltage drop over a long thin cord can make the motor run slower, decreasing its efficiency and eventual lifespan. Or even worse, the increased load on the wire can cause it to heat up, which could result in the wires melting and creating a short or even starting a fire. Always use the shortest cord possible. Check the owner’s manual of the power tool for suggested extension cords.

In this chart you can see how the greater the amps required and the distance traveled, the thicker the cord needs to be.
Please note: this should be used as a rough guide only; always check the operator’s manual for the voltage drop that specific tools can handle.

**Average Power Tool Amperage Ratings:**
- Palm Sander 1.6 to 4 Amps
- Jig Saw 4 to 6 Amps
- Drill 3 to 8 Amps
- Planer 4 to 11 Amps
- Belt Sander 5 to 12 Amps
- Reciprocating Saw 7 to 11 Amps
- Router 11 to 15 Amps
- Circular Saw 10 to 15 Amps

**Additional notes to the video:**

**Circular Saws:**
The leading edge of a spinning circular saw blade cuts in an upward direction. This means that the top face of a piece of wood is likely to splinter. One way to avoid this is to gouge the cutting line with a marking knife, then make the cut immediately next to the line. This makes for an excellent in-class demonstration: make two cuts on a sheet of plywood, one without the marking knife cut, and one with. Another method of avoiding splintering is to make the cut with the backside of the piece facing up.

When making plunge cuts with a circular saw, clamp a straight piece of wood to the surface of the wood being cut to act as a fence for the saw. Even more accuracy can be achieved by marking the stop and end points of the saw’s foot on the wood. Making practice cuts in a scrap piece of wood will provide the proper measurements.

Maintenance of circular saws is another area often neglected. It takes little time to clean the bottom of the saw foot with mineral spirits and a soft cloth after each use. Any burrs or scratches on the foot should be smoothed with emery cloth. Any sawdust from the saw that may hinder the movement of the guard should be cleaned out. A build-up of wood resin on the saw blade can be removed with lacquer thinner. The jigsaw base will also benefit from similar maintenance. These basic tips will ensure smoother and safer sawing.

**Routers:**
Some routers have variable speeds that allow you to adjust the speed of the blade to match the material. Cuts in softwood or cuts with smaller diameter bits generally work best at higher speeds. In contrast, large cuts with large diameter bits or cuts in hardwood work best at slower speeds to avoid burning or chipping the work piece.

The router, with its extensive variety of cutting bits, is quite a versatile finishing tool. This versatility is greatly enhanced by the use of jigs. Jigs make repeat cuts and straight cuts that much more accurate. The video includes the demonstration of a jig that makes the router very efficient in the cutting of dadoes. There are a great many jigs available commercially, as well as plans for making them in the workshop; it’s important that instructors familiarize themselves with their design and use.

**Sanders:**
The right angled sander can be used to remove material quickly by using it slightly off horizontal so that you are putting pressure just on the edge of the abrasive paper. Unlike other sanders, strong pressure can be brought to bear with a right-angled sander because it is gear-driven. Some sanders accept adhesive backed abrasive paper.

Random orbit sanders create a lot of dust, so some of them accept a special abrasive paper with holes in it. The holes in the paper must align with the holes in the pad base. This allows the dust to flow into a special collection container or bag.

Abrasive papers are graded according to the coarseness of the abrasive... the higher the number, the finer the grit, and in turn, the smoother the finish. A 20-grade paper, for instance, is very coarse and is used to shape the wood. A 400-grade paper is much finer and is used for smoothing the wood. And a 1000-grade paper is very, very fine and is used for final finishing. There are also different types of abrasives and they have to be chosen according to the nature of the job. 'Flour paper', for instance, has very fine grit without too much bite that is often used to cut through layers of polish. Garnet paper is made with crushed garnet, which is harder than glass or flint, and therefore has good 'bite'. This abrasive lasts a long time and is a favourite of cabinet makers. Aluminum oxide is also very popular and stays sharp for a long time. When moving from coarse grits to finer grits to finish a project, it is not a good idea to skip ahead too far in choice of grits; for instance, moving from a 100-grade paper to a 180-grade may be tempting, but in fact, will be more time consuming and less efficient than moving to a 140 or 150 first.
**Electric Drills:**
Attachments and accessories are available for many electric drills to make them more versatile. There are guides available for drilling with more accuracy and for simplifying drilling in hard to reach places. You can even get right-angled drill heads to drill around corners. Brushes and wire wheels are available as are polishing and buffing accessories for finishing materials. Grinding stones come in varying sizes and shapes, and motor arbours will enable you to use larger sizes of drill bits. With a suitable drill stand you can easily convert your hand drill into a mini drill press to further increase versatility.

**Answers to Power Tools Quiz:**

**Part One:**
1. Because it is safer and more accurate as cuts may be made in one pass without the need to stop.
2. It must be turned off AND unplugged.
3. Rip, crosscut, combination, specialty
4. There should be no fewer than 2 and no more than 4 teeth in the stock at any given time.
5. Answers will vary – kickback is when the saw rapidly moves back towards to operator in a dangerous manner. It can be avoided by – correct depth of cut, using a sharp blade, correct stance, ensuring that stock is supported, using both hands to control the saw, avoiding awkward positions.
6. Guide line, clamp a straight edge as a guide, use a fence.
7. A cut that starts and stops in the middle of the board.
8. The reciprocating saw
9. Rougher because it moves in a back/forth and up/down motion which gives faster, more aggressive cut.
10. Get proper instruction, read all the manufacturer’s manuals and safety rules.

**Part Two:**
11. 90dBs
12. The belt sander because even though it’s not the loudest, it is often used for the longest period of time.
13. The larger the diameter a wire has, the smaller the gauge number.
14. An extension cord that’s too long can create a type of resistance known as voltage drop, which increases, as the cord gets longer.
15. It is adjusted by moving the front planer shoe up or down which sets the depth of the cut.
16. By avoiding over-reaching at the end of a pass and by keeping pressure on the back of the planer when completing the cut.
17. Drilling, screwing, stripping rust or paint, sanding, polishing, hammering into masonry.
18. Counterclockwise
20. Orbital or random orbital sander

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Hand-Held Power Tools Quiz

Part One:

1. Why is it important to plan ahead when using power tools?

2. What must be done to power tools before adjusting, oiling, cleaning or repairing; attaching an accessory; changing bits, blades or grinding wheels?

3. What are the four types of saw blades used with circular saws?

4. What rule regarding the number of saw teeth makes a blade suitable?

5. Describe what kickback is and how it can be avoided

6. What aids can be used when ripping wood to ensure a straight cut?

7. What is a plunge cut when using a circular saw?

8. Which type of tool is best suited for cutting nail embedded 2 x 4’s?

9. Some jig saws have orbital action. Does this action produce cleaner or rougher cuts and why?

10. As power tools vary from manufacturer to manufacturer what are you recommended to do before using them?
Hand-Held Power Tools Quiz

Part Two:

11. Power tools are loud. Prolonged exposure to any noise can cause gradual hearing loss when the noise exceeds how many decibels?

12. Which power tool is the most ear damaging?

13. What is the rule regarding wire gauges and numbers?

14. What causes voltage drop in power tools?

15. How is the power planer set to remove different depths of cut?

16. How is ‘sniping’ avoided when planing wood?

17. A power drill is a very versatile tool. List some of its uses.

18. Which direction should a router be moved when routing an outside edge?

19. Which sander would be most suitable for removing a large amount of wood?

20. Which type of sander is most suitable for preparing a surface for finishing?