

Hacksaw

Blade Types

Hacksaw blades are available with tooth counts ranging from 14 to 32 teeth per inch. Thin stock calls for finer teeth; thicker metal requires fewer teeth per inch. As a general rule of thumb, three teeth should cover the width of the material.

The way teeth are positioned on a blade is called “set.” There are three typical tooth sets:

- **Regular:** These work well on softer metals that don’t contain iron. The teeth are lined up touching each other and alternating to the left and right.
- **Raker:** Perfect for cutting into thick metals. The teeth are placed in sets of three.
- **Wavy:** The right choice for hard, thin metals. The teeth are set in a wave pattern from left to right for a smooth, fine cut.

Frame Types

Hacksaw frames can be either fixed or adjustable. A fixed frame accepts one blade length; while the adjustable typically handles 10- and 12-inch blades, some can accept blades ranging from 8 to 16 inches. There’s a slight price difference, but the versatility of an adjustable frame is well worth the additional cost.

A hacksaw blade has a hole at each end that fits onto posts on the frame, and these posts can be set in four positions: up, down, left and right. Also, the blade can be mounted on the posts with the tooth side in either direction, giving you a total of eight blade positions to choose from.

Using a Hacksaw

Americans are accustomed to saws that cut on the push stroke, but reversing the blade to cut on the pull stroke — like a fine Japanese woodworking saw — might give you a better result. Whatever the blade’s orientation, it’s essential that you cut slowly, no more than one stroke per second; metal on metal produces tremendous heat and can quickly ruin a blade. A drop of oil on the blade is a good idea to reduce friction and to keep the temperature down.

Hacksaw Safety:

- Choose the correct blade for the material being cut.
- Secure the blade with the teeth pointing forward.
- Keep the blade rigid and the frame properly aligned.
- Cut using strong, steady strokes directed away from you.
- Use the entire length of the blade in each cutting stroke.
- Keep saw blades clean, and use light machine oil on the blade to keep it from overheating and breaking.
- Cut harder materials more slowly than soft materials.
- Clamp, or secure in a vise, the material you are cutting.

Cold Chisel / Punches / Embossing Tools & Striking Tools (hammers, etc.)

1. Wear safety glasses,
2. Use a chisel that's 25 percent wider than what you're cutting.
3. Use a ball-peen hammer. Never hit anything made from hardened steel with a claw hammer.
4. Sharpen the chisel to a 60- to 70-degree bevel. It takes just a few seconds on a grinder to refresh the cutting edges. Use the guide in the chisel set.
5. Don't use a chisel with a damaged end striking end. Grind off any curled metal before it splinters off.
6. Apply a drop of oil to the cutting edges before use. This reduces friction, which increases the tool's cutting ability.
7. Position the work-piece in the middle of the jaws and tighten the vise firmly.
8. To maximize the power of each strike, align the chisel with the vise's screw and cut perpendicular to the jaws.
9. Never use a chisel (or a file) as a pry-bar.

Metal Cut Off Saws

There are a variety of cut off saws in use—**power hack saws**, horizontal band saws, chop saws—but the safety procedures for all are similar.

If your cut off saw has an unusual feature or characteristic, remember to add it to this lesson.

- Make sure the stock is securely clamped in place
 - Keep your hands clear of the path of the blade at all times
 - Let the cut proceed at a comfortable pace—do not force it
 - Monitor the cut as it progresses to ensure that it proceeds smoothly and the saw shuts off on completion
 - Be careful when handling freshly cut pieces as they may be very hot and/or have sharp burrs on them
 - Clean the machine with a brush, not your hand
 - Wear eye protection and appropriate gloves when handling stock
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Throatless Shear

1. Wear Safety Gloves

When dealing with sharp blades and edges, you should always wear thick safety gloves. Kevlar and other durably-coated gloves make excellent choices. You need gloves that can withstand basic punctures and cuts from blades and sharp edges on the sheet metal.

2. Clear Off Your Workspace

An oft-overlooked but simple safety tip when it comes to shear safety is to clear off your workspace before you begin working with your sheet metal shears. Shavings, dirt and other clutter on your workspace can make benchtop shears unstable and can not only mess up your work, but can make your hand slip and make you more susceptible to cutting yourself. Having clutter on your workspace when using shear scissors can make your hand slip as well or make it difficult to cut if the clutter jams in the blades.

3. Hold the Tool by the Handle

An obvious but nevertheless essential safety tip for working with sheet metal shears is to only handle the tool by the handles.

4. Make Sure the Work Area Is Well-Lit

Light can make a big difference when it comes to the safety of using sheet metal shears. Avoid cutting sheet metal in dark rooms so that you can oversee your work carefully.

5. Work Carefully

Even if you're used to working with sheet metal shears, it's important to remember to work slowly and not get so confident that you try cutting the sheet metal too quickly. Work slowly and carefully as you cut sheet metal.

6. Put the Tool Away After Use

It's important that you keep all tools out of the way when not in use. If using a handheld model, return the shears to the storage locker. If using the benchtop model, remove the handle and lock the shear closed.

7. Clean the Tool Regularly

Metal shavings and oil can get caught in your sheet metal shears over time. These can wear down the tool's effectiveness and make it easier to get injured because sheet metal may get caught. At least once a week, if not after each use, you should make sure the tool is free of debris. **Do not clean the blades.** If you notice debris on the shear blades, inform the instructor who will clean them.

8. Preserve the Tool's Cutting Edge

Use only on materials for which the shear is rated (16gauge mild)

Never use "scissor" snips or shears to cut wire or round stock. They will put nicks in the blades.

9. Avoid Waste

Cut shapes from the edge of your material. This will reduce waste/mess and make the best use of your supplies.

General POWER TOOLS SAFETY



Topic	Information
Authorization	You must have authorization from your teacher before using any power tools.
Condition of tools	Only use tools that are in good operating condition. If anything seems wrong with a machine- unusual vibrations or noises-check it out before using the machine.
Personal protective equipment	Wear ear and eye protection when operating all power tools. Long hair must be contained before operating any power equipment.
Know how your machine works	Know which direction your tool will go when you run material through it, and which way the material will go. In other words, make sure you know what is going to happen before you operate a machine so that you can be ready to control those forces.
Lockout	When doing any maintenance work on a power tool, isolate the source of power (unplug it, switch the breaker off and follow written lockout procedures) to ensure that the machine does not start running when you are working on it.
Operator	The power tool operator must be qualified to use the tool. Each power tool is designed for only one operator. This person must always concentrate on the task at hand, so never distract, bump or rush them when they are using a machine.
Path of the tool	Whatever tool you are using, make sure it will cut, drill or grind only what you want to cut, drill or grind-you do not want the saw blade sticking out the bottom of the stock, the cutter hitting the top of a vice, or the drill bit breaking through the stock. Be aware of the cutting path of the tool-keep your hands away from this area. Make sure the cutting part is not going to come in contact with the power cord.
Power cord damage	Check all power cords daily for tears or cuts in the insulation, loose connections (plug to wire, wire to tool) and good groundconnections.
Secure your work	When working with portable power tools, make sure the material stays in place-put stock in a vice, or clamp it to a workbench before approaching it with a power tool. While operating the tool, maintain a firm grip at all times.
Start-up	Check to ensure all guards and safety devices are in place and functioning properly. Make sure the power switch is in the off position before plugging in a portable power tool. Only the operator is to turn the tool on.
Stay beside running power tools	Do not walk away from a machine you have been using until it comes to a complete stop - it takes only a few seconds for a power tool to 'wind down' after it has been shut off.
Stop to make adjustments	Always unplug or lockout the tool before making any adjustments or changing settings where there is danger of being injured in the event of start up of the tool.

PORTABLE POWER TOOLS SAFETY



Topic	Information
Damaged power cord	Do not use tools if the power cord is damaged. The insulation should be intact and without tears, the ground connection should be working if the tool is designed with a ground, and the connections plug to wire and wire to tool should be solid. Fix or replace damaged cords
Direction of the tool and material	Understand which way the action of the tool will push the material and the tool itself. Usually they try to go in opposite directions. Power planers push the stock away and the tool towards the operator. Belt sanders do the opposite. Right angle grinders depend on which part of the wheel you grind with. The point is to make sure you know what is going to happen and are ready to control those forces. Hold that tool with a firm grip.
Ear and eye protection	Many portable power tools run at very high speeds and scream in operation. Wear hearing protection if the tool is noisy or you have to raise your voice to speak to others. Wear eye protection when using portable power tools.
Path of the tool	Make sure the path of the tool is clear. Saw blades stick out the bottom of the stock. Will they cut anything unintentionally? Is the cutter on your router or power planer going to hit the top of the vice? When the drill bit breaks through, where is it going? Whatever tool you are using, make sure it will cut, drill or grind only what you want to cut, drill or grind! Make sure the cutting part is not going to come in contact with the power cord.
Power switch	Check that the power switch is in the off position before plugging in any portable power tool.
Secure your work	Large machines stay in place while the material moves. With portable machines, the tool moves and the material is supposed to stay in place-make sure it does! Put the stock in a vice, clamp it to a work bench or wedge it in a corner, but don't try to hold a small piece of material in one hand while you approach it with a power tool held in the other.
Unplug the tool	Unplug the tool whenever you are changing bits, replacing blades or fixing something on the tool. You could easily bump the trigger unintentionally while handling the tool. Keep the plug within your sight and control so that it doesn't get inadvertently plugged in while you are working on the tool.

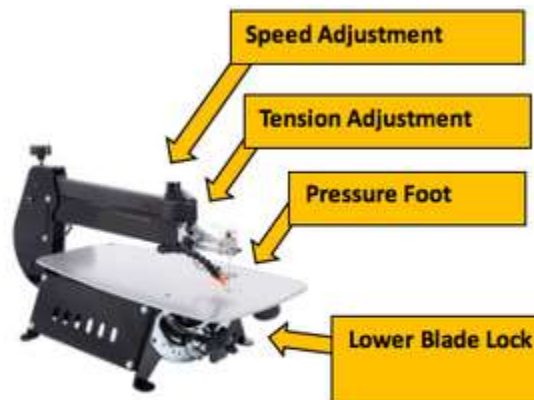
ELECTRIC HAND DRILL SAFETY

- Secure your stock before drilling. Large pieces may be stable on their own, but smaller pieces should be held in a vice. If there is any chance that the stock could catch on the bit and spin around, secure it in a vice or clamp. Keep the cord away from the drilling area.
- Centre punch metals before drilling. Many of you have had the experience of trying to use a hand drill on a piece of metal only to find the bit scooting all over the surface. A small dimple made with a punch will keep the bit in place.
- Make sure the bit is properly sharpened, and straight and tight in the chuck.
- Tie long hair back-otherwise power equipment must not be used. Bending over your work or lifting the drill in the air are perfect opportunities for the electric hand drill to grab a strand or two.
- Large drills are powerful enough to break your arm, so make sure you have a good grip on the drill and be prepared to hold it if it 'kicks,' especially as the bit passes through the far side of a piece of metal.
- Both eye and hearing protection are required when using an electric hand drill.

The scroll saw is a cutting tool with a very thin blade. It is used for cutting sharp curves and intricate designs into thinner stock. The blade travels up and down very quickly in order to cut the wood.

Important Parts:

- Speed adjustment
- Tension adjustment
- Table
- Pressure foot



Information Sheet

BENCH GRINDER SAFETY

◦ Inspect the grinder prior to use to ensure there are no cracks in the abrasive disc.
◦ Check there are no flammables in the area of the grinder.
◦ Use wheel dressing procedures when required.
◦ Keep the tool rest within 1.5mm of the stone at all times. If there is too much room between the stone and the rest, your work could jam causing the stone to shatter. At the speed it is turning, you don't want that to happen.
◦ If the stone has a flaw, it is most likely to fly apart as it speeds up, just after you start it. Always stand to the side when starting the grinder, just in case.
◦ Only grind on the face of the stone, never on the side-it could explode in your face.
◦ Work should be moved back and forth across the face of the stone to avoid creating a groove in the center.
◦ Use moderate pressure when grinding. If you push too hard, you will stress the machine and the stone, and generate unnecessary heat in the material you are grinding.
◦ Avoid grinding small pieces or, if necessary, hold them firmly in vice grips. Small pieces could easily be pulled out of your grasp and cause problems.
◦ Do not grind either sheet metal or soft metals like brass or aluminum on the grinder. Sheet metal vibrates too much and can easily get caught, and non-ferrous metals such as aluminum can quickly plug up the stones.
◦ Grinding generates a lot of heat in the metal being ground. Cool your material regularly and take care not to burn yourself when it is hot. If you are using the grinder to sharpen tools, be aware that too much heat can ruin the temper in tool steel- this is not good for your tools.
◦ Full face shield, leather apron and hearing protection are required.

Information Sheet

BUFFER/WIRE WHEEL SAFETY

◦ The biggest danger on the buffer or wire wheel is having the wheel grab your work. This could happen if the wheel were to hook on a corner or the edge of your work. To prevent this from happening, hold your work so the wheel is spinning off the corners.
◦ Hold your work against the wheel just below the middle point. If the wheel should grab it, it will throw it down and away from you.
◦ Buffing can generate a fair amount of heat, so handle your work with care to avoid getting burnt.
◦ Strands of wire from the wire wheel can come loose. Be sure to wear eye protection.

DRILL PRESS SAFETY

<ul style="list-style-type: none"> ◦ Tie long hair back.
<ul style="list-style-type: none"> ◦ Remove all strings and/or jewelry that could get caught in the drill press.
<ul style="list-style-type: none"> ◦ The material you intend to drill must be held in the drill vice or be clamped to the drill table. This will prevent it from spinning around and hurting you if the drill bit were to catch as it went through.
<ul style="list-style-type: none"> ◦ Be sure to 'centre punch' hard materials like metals before you drill them. The punch mark will prevent the drill bit from slipping around as you try to start the hole.
<ul style="list-style-type: none"> ◦ Set appropriate drill speed for the drillbit.
<ul style="list-style-type: none"> ◦ Make sure the chuck key is out of the chuck every time you go to start the drill.
<ul style="list-style-type: none"> ◦ If you are drilling a series of holes or are in a rush to get onto the next job, slow down to make sure the bit is clear of the stock before you move it. If you do move the stock when the bit is still in the hole, you could break the bit.
<ul style="list-style-type: none"> ◦ Set up your operation to avoid drilling into the vice or table. Put some scrap wood under your work, or position it in the vice so that the bit will come through in the centre or at the side of the vice.

DRILL BIT RPM CHART

		Maximum RPM- HSS Bit			
Drill Size	Decimal	Aluminum	Mild Steel	Cast Iron	Stainless
1/16	0.0625	18336	6723	6112	4278
3/32	0.09375	12224	4482	4075	2852
1/8	0.125	9168	3362	3056	2139
9/64	0.140625	8149	2988	2716	1902
5/32	0.15625	7334	2689	2445	1711
3/16	0.1875	6112	2241	2037	1426
7/32	0.21875	5239	1921	1746	1222
1/4	0.25	4584	1681	1528	1070
9/32	0.28125	4075	1494	1358	951
5/16	0.3125	3667	1345	1222	856
3/8	0.375	3056	1121	1019	713
1/2	0.5	2292	840	764	535

DRILL TOOL RPM CHART

Typical Tool RPM Chart

tool	RPM
1/2" Corded Drill:	600-1200
18V Cordless Drill	1500-1800
Drill Press	See chart inside