

Metal Working Tools & Uses: Cutting, Filing, Shaping & Drilling

Anvil: An **anvil** is a large, heavy steel object used to shape metal. An anvil can be used to flatten out, bend, punch holes and cut metal. An anvil has four main parts; the face, the horn, the hardy hole and the pritchel hole. The face, which is the large flat area on top of the anvil, is used to flatten out metal. The anvil horn is used to make bends in metal. The pritchel hole is used to punch holes in metal. The hardy hole holds a hardy, square-shanked chisel used to cut metal. Anvils are commonly used in horse shoeing to shape horseshoes to the horses' hooves.

- To flatten out metal using an anvil:
 - Grasp the metal to be flattened out firmly using either thick leather welding gloves or locking pliers.
 - Place the bent section of metal over the face of the anvil with the bend facing upwards. Using either a ball peen or blacksmith's hammer, strike the bend against the face of the anvil until the bend is removed.
- To bend metal using an anvil:
 - Grasp the metal to be bent firmly using either thick leather welding gloves or locking pliers.
 - Place the section of the metal to be bent over the horn of the anvil.
 - Using either a ball peen or blacksmith's hammer, strike the metal over the anvil horn.
 - Move the metal a little at a time and continue striking the metal over the anvil horn with the hammer until the desired bend is made.
 - The metal may be heated to make forming easier.
- To punch holes using an anvil:
 - Measure and mark the location of the desired hole.
 - Grasp the metal to be punched firmly with locking pliers.
 - Heat the area to be punched out until it is red hot. Place the mark over the pritchel hole on the face of the anvil.
 - Using the tapered end of a pritchel punch, drive the punch thru the metal into the hole on the anvil to make the hole.
- To cut metal using an anvil:
 - Place the hardy into the hardy hole on the anvil.
 - Measure and mark the location where the metal is to be cut.
 - Grasp the metal to be cut firmly using locking pliers.
 - Heat the area marked until cherry red.
 - Place the mark over the hardy.
 - Using a ball peen or blacksmith's hammer, strike the metal over the hardy until it is cut in two.

Awl: A tool, which has a sharp pointed steel tip used to mark metal by scratching it.

Center punch: A steel punch with a sharp end used to mark the center of holes. It also can be used to make permanent marks on a soap stone or metallic sliwer line, which will not rub off as the material is handled.

Chisels: A chisel is a hand tool made of tool steel, which has been tempered and sharpened to cut metal. Chisels come in many different shapes and sizes. A cold chisel is a chisel with a wide, flat cutting edge. A cape chisel has a long tapered tip with a very sharp pointed edge. A diamond point chisel has a tapered tip with a diamond-shaped point. Chisels have many uses, such as cutting metal and removing rusty bolts.

- To chisel metal:
 - Secure metal to be chiseled on firmly in a vise or with another other type of clamp.
 - Select correct chisel for job.
 - Visually inspect chisel for cracks and sharpness of blade.
 - Grasp chisel firmly in one hand with chisel point away from body. Rest point of chisel on metal. Strike the blunt end of the chisel with a hammer.
- To cut metal with a chisel:
 - Use a soapstone or awl to mark where the metal is to be cut.
 - Secure metal firmly in a vise with the cut mark aligned with the top of the vise jaws.
 - Cutting metal with a chisel is a shearing process. The jaws of the vise make up one side of the shear; the chisel makes up the other side. Grasp the chisel firmly in one hand while resting the point of the chisel on the vise jaws up against one end of the metal to be cut. Strike the blunt end of the chisel with a hammer to begin cut. Continue driving chisel through metal until it is cut.

Files: A file is a hand tool used to remove material from or smooth the edges of metal. Files are very useful when working with metal. Files come in many different shapes and sizes. The four most common types of files are classified by their shape: triangular, half-round, round and flat. Files are available in two different styles— single cut and double cut. A single cut file has cutting teeth in one direction only. A double cut file has two sets of cutting teeth placed in a criss-cross pattern. A double cut file cuts metal faster than a single cut file. Files can be purchased with different levels of coarseness. A file only cuts when pushed forward.

- To file metal:
 - Secure small metal objects to be filed in a vise or clamp them so they will not move while being filed.
 - Grasp the file firmly with one hand on either end of file. Push the file forward across the metal while applying light pressure on the file against the metal. At the end of the stroke, lift the file slightly and pull the file back to the starting point.
 - Repeat the process until the desired amount of metal is removed.

Hacksaw: A toothed saw used to cut metal. Hacksaws also are commonly used in plumbing and electrical wiring. Blades are available with 14 to 32 teeth per inch. A blade should be selected, which has at least three teeth in contact with the metal being cut.

- To cut metal using a hacksaw:
 - Secure smaller pieces of metal to be cut firmly in a vise.
 - Measure and mark the location where the metal is to be cut.
 - Holding the handle of the hacksaw with one hand, rest the blade of the hacksaw on the mark. Place the other hand on the end of the frame away from to the blade to aid in starting the cut on the mark. Push hacksaw forward with some force to begin cut. Pull hacksaw back and push forward again. Once the cut has started, the free hand may be moved away from hacksaw for safety. Continue cutting metal by pushing hacksaw forward with some force, then pulling it back.

Hydraulic iron workers: Hydraulic iron workers are found in many school laboratories in most fabrication shops. The machines are rated in tons and can be used to shear many sizes and

shapes of steel to length, to punch holes, to brake, to notch and to cope steel and pipe. It is essential for all operational and safety procedures to be followed when operating an iron worker.

Metallic silver pencils: Cedar pencils with a metallic silver center. Can be sharpened with a pencil sharpener and will mark well on damp or oily metal.

Oxy-fuel and plasma cutting: Oxy-fuel and plasma torches are often used to cut metal. Oxy-fuel also may be used to shape metal. Be certain you have the teacher's permission and you completely understand the operational and safety rules and precautions before you attempt to use this equipment.

Soapstone: A soft white stone, which will mark on most metals, similar to chalk.

Tin Snips and Compound Snips: Snips are scissor-like tools used for cutting thin metals, such as sheet metal. Snips are used just like scissors and are available in straight cut, left cut and right cut models. Be very careful of sharp edges when cutting sheet metal.

Twist drills: High speed twist drills are recommended for drilling holes in metal. Straight shank twist drills are commonly used, but Morris taper twist drills are better for larger holes. As the diameter of the twist drill increases, the drill speed in revolutions per minute should decrease. A ¼ inch twist drill may operate at 1,000-2,000 r.p.m. and a ½ inch twist drill may operate at 450-600 r.p.m. Cutting and threading oil should be used as a lubricant to reduce friction and to keep the twist drill cool. Twist drills are available in standard and metric sizes. When drilling with a drill press, the metal being drilled should be secured in an appropriate drill press vice. When operating hand drills, the drill must be held securely to prevent injury.

Vise: A vice is a heavy steel object used to hold objects securely so they may be worked with. Vises are usually mounted on a tabletop or workbench. Vises can be used for many metalworking projects.

- To make a 90 degree angle using a vise:
 - Measure and mark the intended location of the bend.
 - Place the mark inline with the top edge of the jaws of the vise and tighten the vise to firmly secure the metal in place.
 - Using either a ball peen hammer or a blacksmith's hammer, strike the metal to be bent just above the jaws of the vise. Continue striking the metal just above the vise jaws until the metal is bent into a 90 degree angle.
 - Once the metal is bent, loosen the vise and remove the metal.
 - Thicker metal may be heated to make forming easier.
- To make a twist in metal using a vise:
 - Measure and mark the area of the metal to be twisted.
 - Place the bottom mark in line with the top edge of the jaws of the vise and tighten the vise.
 - Using an adjustable wrench, grasp the metal on the top mark and turn the wrench slowly to twist the metal.
 - Lengthening or shortening the distance between the marks can adjust the size of the bend.
 - On thicker metal it may be helpful to heat the metal before twisting.