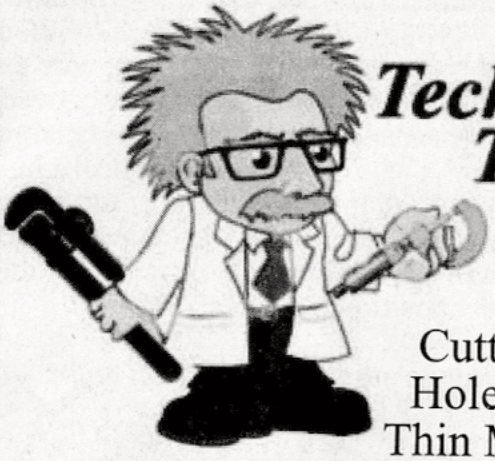


Tech-Tips

Cutting Holes in Thin Metal

by Lee Carroll

Getting a perfect hole in sheet metal is a dedicated art. There are special techniques that help make a hole in the exact position that you require. The hole may be anywhere from a fraction of an inch up to several inches in diameter. There are several pitfalls to be aware of even before you begin to drill, cut or punch your hole.

The first caveat is that trying to drill a hole in metal will generally result in the drill bit 'walking' across the work. Not only could this result in a hole drilled in the wrong position, but on a finished piece, the walking could result in a 'track' left by the bit walking across the metal's surface.

The second thing to be very aware of is that a drill bit, or even a hole saw, can grab the metal and spin it. That spinning sheet metal is a knife blade; if it touches flesh, it is going to draw blood or even worse.

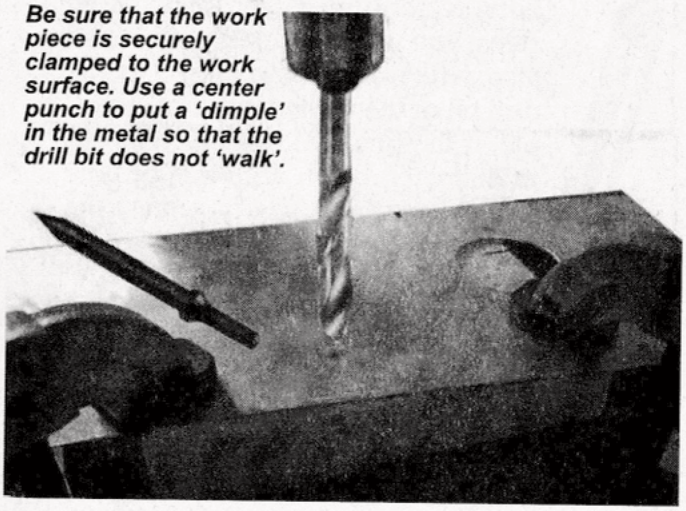
The spinning metal can also leave swirl marks on the back side of the metal. On a finished piece, this could result in having to refinish the metal. Clamping the metal to the drill press table or a work bench will reduce the chance of spinning, but the clamps – at least two of them – should be used with a block of wood or a pad so that the clamps themselves do not dent or mar the metal.

Drilling or cutting a hole in metal creates a lot of heat. If the correct techniques and the correct tools are not used, that heat can easily ruin a drill bit or hole saw. The rotation must be slower than if drilling in wood, and generally the use of a cutting fluid will help to lubricate and to cool the work.

Cutting fluids vary in their content, but generally contain some type of oil or wax which acts as a lubricant and cooler. Softer metals - brass, aluminum, copper - do not generally require cutting fluid, if the work piece is thin. Cutting fluid should not be used with cast iron.

Finally, drilling or cutting with a hole saw can leave exit marks on the back side of the work. Again, on a finished piece this could mean re-finishing. On an unfinished piece, drilling, cutting or spinning might result in an unanticipated job of finishing the back side of the metal.

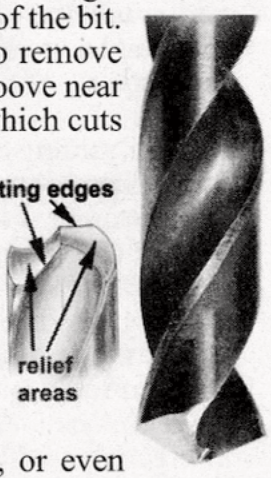
There are essentially five methods of creating a hole in metal: drilling, saw-cutting, punching, snip-cutters or torch cutting. We will not look at torch cutting in this article; we'll concentrate on the mechanical methods of creating a hole.



Be sure that the work piece is securely clamped to the work surface. Use a center punch to put a 'dimple' in the metal so that the drill bit does not 'walk'.

Preparation is the very first step in creating a hole. There are two types of holes: round and irregular shaped holes. The work piece must be marked before beginning to create the hole. Mark the center of a round hole with pencil or scribe. Double check the position. When you are certain of the position of the center, use a sharp-point punch and a ball-peen hammer. Tap the center punch just enough to create a dimple in the metal. As you punch it, it will deform the metal. Minimize the dent by punching a depression just deep enough to keep the drill bit from walking. Placing a piece of masking tape on the back side of the work piece at the point of the hole and large enough to cover the entire diameter of the hole will minimize exit marks.

A drill bit creates a hole by cutting the metal. The bit is a shaft with a groove, or grooves, running the length of the bit. The grooves are designed to remove the chips. The edge of the groove near the bottom edge is a blade which cuts the metal. Drill bits are designed to cut a vertical hole. They should not be used to cut horizontally or to elongate or increase the size of a drilled hole. That is a job for an end mill bit in a mill.

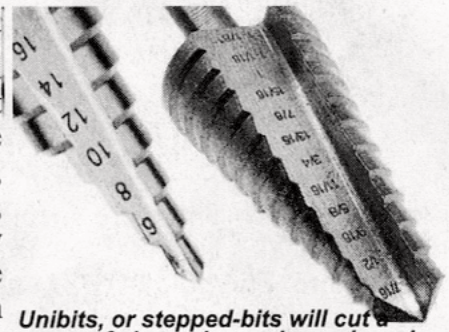


Use a small drill bit, or even better, a starter bit, to create a pilot hole. By drilling to the final size in steps, you will get a cleaner hole and also will minimize damage to the drill bit or the work piece. For example, if the final hole size is to be ½" in diameter, begin with a pilot hole of about 1/8" or a 3/16". Increase the drill bit size by about 1/8" increments, until you reach the ½" size. When drilling through steel or other hard metal, a few drops of cutting fluid will help. The tendency is to use a higher drill speed to cut a hole, but actually you will probably do better to use a slower drilling speed. It will help keep the temperature down so as not to ruin the drill bit.

A starter bit is designed specifically for starting a pilot hole.

Optionally, a stepped bit, or a unibit will allow you to drill a larger hole without having to stop and change drill bits. For example, a 1/8" to ½" unibit could have between ten and thirteen steps, each one slightly larger than the previous one. A unibit will drill a hole up to about 1" diameter. Using a unibit eliminates the need for a pilot hole, but the punched dimple will assure that the hole is drilled into the correct position.

Unibits are often marked as to the size of each hole. They may be marked as to a bolt hole size (example 8, 10. 12, 14, etc.), or they may be marked in inch increments (1/4", 5/16", 3/8", 7/16" etc.).



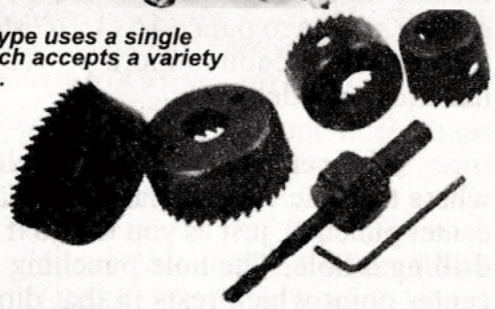
Unibits, or stepped-bits will cut a range of sizes when using only a single bit. They are most effective when used in a drill press. Often the bits are marked with the step sizes.

A hole saw differs from a drill bit in that the cutting edge is actually a saw fitted in a circular pattern. Although the cutting motion is rotary, the hole saw cuts like a saw rather than cutting with the edge of the shaft like a drill bit. A hole saw generally has a drill bit that centers the tool. The hole saw starts by drilling a starter hole. The center drill holds the saw in the correct position to cut a larger hole. A piece of scrap wood clamped under the work piece will give the drill bit a more positive anchor.

A hole saw often comes in sets ranging from 1" and up. Whereas a drill bit is used in a series of increasing sizes to drill a larger hole, a hole saw should be selected to cut the actual finished size of the hole. It cannot be effectively used once the initial hole is cut. (If the pilot hole is drilled into a thick piece of stock, and the work is clamped to it, the hole saw size can be increased.)

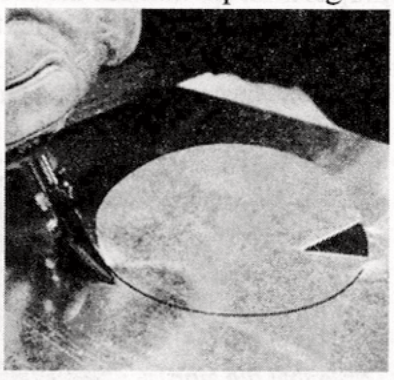
Hole saws come in a variety of configurations. Some have carbide or tungsten teeth, and some just have hardened teeth. Avoid cheap hole saws; they are generally designed for wood and will not stand up to the job of cutting through metal. Hole saws are available in fixed configurations – that is, the blade is permanently affixed to the center arbor. Others come with a single arbor and the saw bit can be changed depending on the hole size desired.

Some hole saws are fixed to the arbor.



Another type uses a single arbor which accepts a variety of cutters.

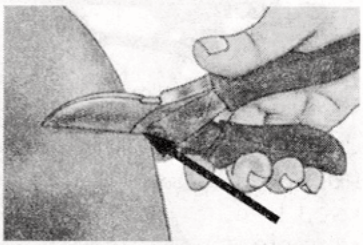
Both of the techniques above are used for making a round hole. If an odd size or irregular-shaped hole is needed, or if a larger sized hole is required, the shape must be scribed onto the work piece. A starter hole must be cut or punched so that tin snips or a sabre saw can be used to cut out the necessary shape. The starter hole has to be drilled inside the pattern in the part that will be scrap. Using tin snips properly can be an article in itself, but basically there are three types of tin snips – straight blade, left and right curved snips. Tin snips are also known as aviation or compound snips.



Aviation snips with a red handle are designed for cutting in a counter-clockwise direction. The edges of the metal are sharp. Wear gloves.

Snips designed to cut clockwise curves have a green handle; those designed to cut counter-clockwise have a red handle. The straight-blade snips will have a yellow handle; they can be used to cut right or left, but the curved snips do a better job. The blades are offset to give you the best cut in the direction needed.

It is recommended that heavy gloves be worn; the edges of the cut metal are sharp, and the scrap cut off has to be pulled out of the way to allow for a good cut. The starter hole must be big enough for the tip of the snips to get a 'bite' on the metal. Open the snips as wide as possible and take long, smooth cuts, with the edge of the work as close to the pivot point as possible. This method works better than trying to 'nip' away with small bites into the metal. Use the scribed mark as a guide for cutting.



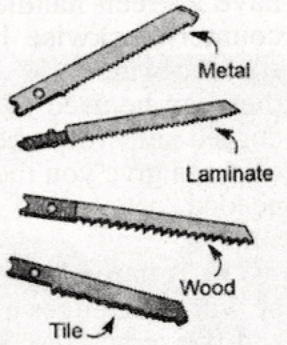
Get the workpiece as close to the pivot point as possible.

Practice on scrap sheet metal before trying to cut the work piece; you will make mistakes and it's better to do so on scrap than on the finished work piece.

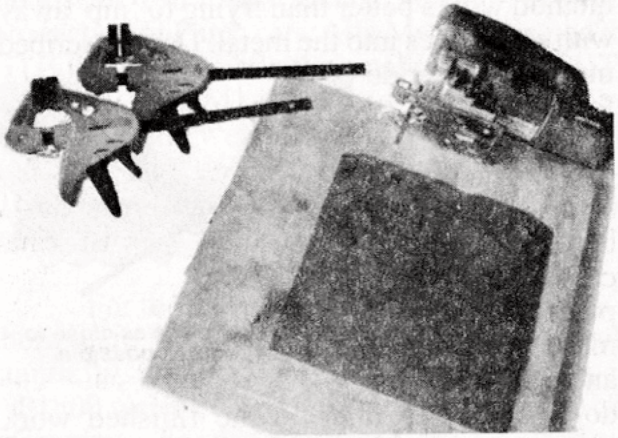
We will touch only briefly on the sabre saw (sometimes called a jig saw). It is a portable machine with a narrow blade that moves in a vertical direction. There are basically two types of these saws, and so the names for them sometimes get confusing. It is generally acknowledged that the jig saw's blade remains in a position parallel with the saw's body. A sabre saw has a knob so that the blade can be rotated in several directions. It is particularly important when using a power tool, to wear eye protection.

Blades for sabre/jig saws come in a variety of tooth coarsenesses depending on the type of material that you are cutting. There are very coarse blades for fast, rough wood cutting,

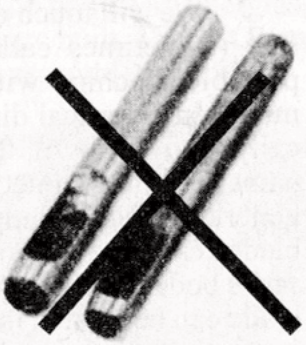
special plywood blades, blades for acrylic and plastics, and even a knife edge blade for cutting drywall or sheetrock. A metal cutting blade is most often a very high tooth count blade giving a smoother cut to metal. Select the right blade for the job, and the tool will perform much better.



When cutting thin metal with a power saw, clamp the work to a piece of sacrificial wood, and cut through both the metal and wood at the same time. The wood reduces the tendency for the metal to catch on the saw's blade and vibrate up and down.



The last method of creating a hole in metal is the punch. Remember, we are discussing metal. The hand punches that you use for paper, or for rubber gaskets, leather gaskets or for paper gaskets are not suitable for metal. These punches, when used on metal, will bend and distort the work piece, even if used with a backing board.



A metal punch, and there are a variety of configurations, has a punch die and a matching anvil. The anvil will prevent the metal from bending or distorting while the punch die cuts the hole.

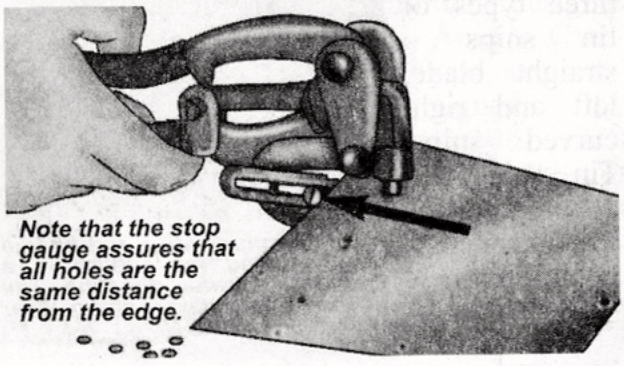
The final tool that we will look at is the hand hole punch. We specifically wrote 'hand hole punch' to differentiate it from the larger bench mounted units.

The hand hole punch consists of a plier-like handle which accepts a hole-punching die and a matching anvil. This is an extremely useful tool for punching small holes - up to about 9/16". A 9/16" hole will accept a 1/4" bolt. There are three limitations to this tool: first is the hole size, as mentioned above. The next is the throat depth of the tool. Normally the throat depth will not exceed two inches which means that the hole cannot be punched more than two inches from the edge of the work piece. The final limitation is the metal gauge, or thickness of the metal. Often quoted as able to punch 16 (1/16" steel), anything thicker requires more power than this hand tool can deliver.

The center of the hole (well actually where the hole will be) has to be marked and center punched, just as you would if you were drilling a hole. The hole punching die has a center point which rests in that dimple. The hole will be punched around it.

The correct sized die and anvil are placed into the handle assembly, and the depth of the hole from the edge set by adjusting a stop gauge on the handle. This assures that all of the holes are equidistant from the edge. Squeeze the handle and the hole is punched. The metal plug will drop out, and the tool can be removed and set in postion for the next hole.

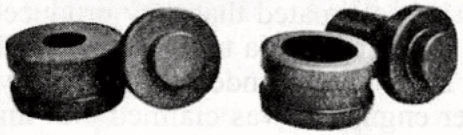
When punching a number of holes which are to be the same distance from the

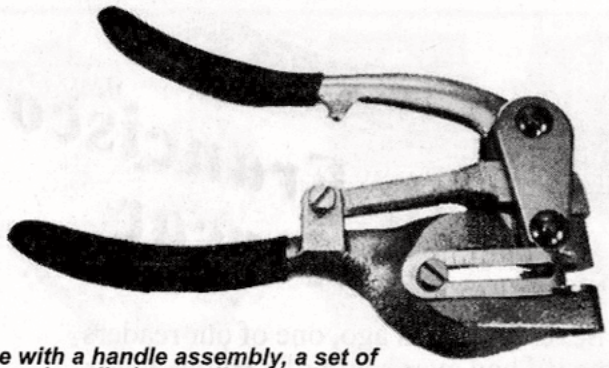


Note that the stop gauge assures that all holes are the same distance from the edge.

edge of the work piece, the hole punch is faster and cleaner than using a drill.

Most hole punch kits will come complete with the handle assembly, a set of dies, matching anvils and an adjustment tool.





Most kits come with a handle assembly, a set of matching dies and anvils (generally covering 6 to 8 sizes), an adjustment tool (not pictured) and a carrying case (not pictured).

S.K.

Metal gauge numbers differ depending on the type of material being used. Steel is the basic standard, but stainless, galvanized, and non-ferrous metals (copper, brass, aluminum, zinc) are treated and graded separately.

Since most hand punches are rated at 16 gauge (steel) and higher, the chart reproduced below covers thicknesses up to gauge 16. NOTE: the higher the gauge number, the thinner the metal.

GAUGE TO THICKNESS CHART

Gauge		Sheet Steel	Stainless	Galvanized	Aluminum
	Fraction	inches (mm)	inches (mm)	inches (mm)	inches (mm)
30		0.0120 (0.30)	0.0125 (0.33)	0.0157 (0.40)	0.0100 (0.25)
29		0.0135 (0.34)	0.0141 (0.36)	0.0172 (0.44)	0.0113 (0.29)
28	1/64	0.0149 (0.38)	0.0156 (0.41)	0.0187 (0.47)	0.0126 (0.32)
27		0.0164 (0.42)	0.0172 (0.43)	0.0202 (0.51)	0.0142 (0.36)
26		0.0179 (0.45)	0.0187 (0.48)	0.0217 (0.55)	0.0159 (.40)
25		0.0209 (0.53)	0.0219 (0.56)	0.0247 (0.63)	0.0179 (0.46)
24		0.0239 (0.61)	0.025 (0.64)	0.0276 (0.70)	0.0201 (0.51)
23		0.0269 (0.68)	0.0281 (0.71)	0.0306 (0.78)	0.0226 (0.58)
22	1/32	0.0299 (0.76)	0.0312 (0.79)	0.0336 (0.85)	0.0253 (0.64)
21		0.0329 (0.84)	0.0344 (0.86)	0.0366 (0.93)	0.0285 (0.71)
20		0.0359 (0.91)	0.0375 (0.95)	0.0396 (1.01)	0.0320 (0.81)
19		0.0418 (1.06)	0.0437 (1.1)	0.0456 (1.16)	0.0359 (0.91)
18		0.0478 (1.21)	0.0500 (1.27)	0.0516 (1.31)	0.0403 (1.02)
17		0.0538 (1.37)	0.0562 (1.4)	0.0575 (1.46)	0.0453 (1.1)
16	1/16	0.0598 (1.52)	0.0625 (1.59)	0.0635 (1.61)	0.0508 (1.29)