Cutting Processes Guide

Every cutting process has particular benefits and shortcomings that you should take into account before deciding on a cutting method. Also keep in mind that a combination of processes may be best for a particular application.

Cutting Process	Laser	Plasma	Oxy-Fuel	Other Mechanical Saw, Shears, etc.
Materials	Metal, wood, plastics, foam, materials	Most electrically conductive metals	Carbon steel	Metal, wood, plastic
Thickness	Historically used on thinner materials but can cut up to 1¼"(32 mm)	Up to 3" (75 mm) handheld Up to 1¼" (32 mm) mechanized pierce	Range of thicknesses	Typically up to 1" (25 mm)
Cut Quality	Excellent quality with high tolerances	Good quality, may require some secondary operations	Ranges from poor to very good quality depending on the operator's skill	Very good quality if operator is skilled and using low cutting speeds
Productivity	High productivity on thinner materials	Medium	Low, though can be improved by running multiple torches simultaneously	Low
Speed	High cut speeds for thinner materials, low cut speeds for thicker material	Medium	Slow cut speeds, multiple torches can help increase productivity	Slow cut speeds
Secondary Operations	—	Grinding sometimes needed	Grinding and surface oxidation removal almost always needed	Filing or grinding almost always needed
Portable	No	Yes (air plasma systems only)	Yes	Yes
Heat Affected Zone	Yes	Yes	Yes	Possibly
Operating Cost	$$$ (Higher cost for CO_2 lasers)	$	$$	$$$$

Source: Hypertherm®

Air-Carbon Arc Cutting and Gouging (CAC-A)

In air carbon arc gouging, an electric arc is generated between the tip of a carbon electrode and the work piece. The metal becomes molten and a high-velocity air jet streams down the electrode to blow it away, thus leaving a clean groove.

The process is simple to apply, has a high metal removal rate, and gouge profile can be closely controlled. Disadvantages are that the air jet causes the molten metal to be ejected over quite a large distance and, because of high currents (up to 2000A) and high air pressures (80 to 100 psi), it can be very noisy.

An arc-gouging operator should follow the Recommended Practices for Air-Carbon Arc Gouging and Cutting (AWS C5.3), Recommended Safe Practices for Welding and Cutting Containers (AWS F4.1), and Safety and Welding and Allied Processes, (ANSI Z49.1). For more information, visit the American Welding Society at aws.org.

DC (electrode positive) is normally preferred for steel and stainless steel, but AC is more effective for cast iron, copper and nickel alloys. Typical applications include back gouging, removal of surface and internal defects, removal of excess weld metal and preparation of bevel edges for welding.

Air Consumption for Arc Gouging

Electrode Size	Application	Pressure (PSIG)	Consumption (CFM)
1⁄8"	Intermittent-duty, manual torch	40	3
1⁄4	Intermittent-duty, manual torch	80	9
3⁄8"	General-purpose	80	16
3⁄4"	Heavy-duty	80	28
5⁄8"	Semiautomatic mechanized torch	80	25
Flat	Precision	80	25–30

Recommended Current Range for Arc Gouging

Electrode Size	1⁄8"	5⁄32"	3⁄16"	1⁄4"	5⁄16"	3⁄8"	1⁄2"	5⁄8"	3⁄4"
DC Electrode with DCEP (Amps)	60–90	90–150	200–250	300–400	350–450	450–600	800–1,000	1,000–1,250	1,250–1,600
AC Electrode with AC (Amps)	–	–	200–250	300–400	–	350–450	–	–	–
AC Electrode with DCEN (Amps)	–	–	150–180	200–250	–	300–400	–	–	–

Oxy-Fuel Cutting

There are two major selling points for oxy-fuel: the equipment is inexpensive and you can be up and running fairly quickly. However, the process is comparatively slow and it's only good for cutting carbon steel; oxy-fuel is not effective on other types of metal such as stainless steel or aluminum. In addition, the carbon steel workpiece must be preheated before cutting, further reducing productivity. There are also safety issues associated with the ammable and unstable acetylene, the most common fuel gas used with this process.

Oxy-fuel is a good choice for those who primarily need to cut thick (more than 51 mm or 2") carbon steel. In addition, oxy-fuel can be an economical alternative if you don't have many parts to cut and aren't especially concerned about productivity or per-part pr The process does require a little more training and operator expertise. However, a skilled operator can achieve very good cut quality with oxy-fuel.

After cutting parts with oxy-fuel, the parts are heavily oxidized and need considerable (time-consuming) clean-up, often including heavy grinding to remove dross.

Plasma Arc Cutting (PAC) and Gouging

When a gas has been ionized, it no longer meets the usual definition of a gas and is considered to have changed to the fourth state of matter known as Plasma. Lightning is a recognizable form of plasma.

Plasma arc cutting is an excellent choice for most cutting applications but it is particularly well-suited for applications where speed and excellent cut quality are important. Because of the intense heat of the plasma arc (around 40,000˚F) compared to 5,700˚F with gases used with Oxy-fuel cutting, the cut is very clean with little or no dross.

The plasma process offers advantages such as it also cuts ferrous and non-ferrous metals much faster than an oxy-fuel torch or abrasive saws, with low or no heat-affected zone, especially on thinner metals. Less preparation work is required because a plasma arc is hot enough to burn through most surface coatings, such as paint and rust, and still provide excellent cutting results.

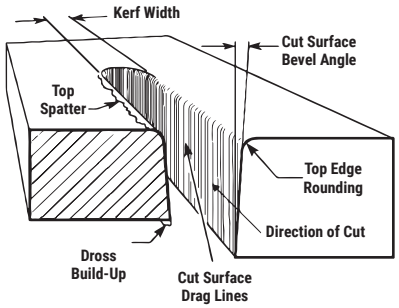
Plasma vs. Oxy-Fuel: Carbon Steel Cut Performance

System	Thickness	⅛"	¼"	⅜"	½"	⅝"	¾"	1"	1¼"
Plasma	12 Amp	22	9						
	27–30 Amp	63	34	17	9				
	40 Amp	190	65	34	24	13			
	60 Amp	264	132	63	42	31	22	12	6
	80 Amp	432	161	94	60	40	31	16	8
	100 Amp	456	208	119	88	61	47	28	19
Oxy-Fuel		27	26	23	20	18	17	14	13

Source: Hypertherm®

Parts of a Cut

- Bevel Angle
- Direction of Cut
- Drag Lines
- Top Spatter
- Dross
- Top Edge Rounding
- Kerf Width



The best applications for plasma arc cutting include ventilation ductwork (HVAC being handled or cut. cult shapes are

Selection of a plasma arc cutting system is based on the type and thickness of the metal to be cut and the speed at which the metal needs to be cut. The higher the plasma arc cutting system's ampere and duty cycle rating, the thicker and faster it will cut. Plasma cutters utilize a three-category capacity rating system. This rating system makes it easy for the end user to choose the right system for the right application.

Rated Capacity

- Optimum system performance
- Cut speeds of at least 20 inches per minute (IPM)
- Ideal operating range for excellent cut quality

Quality Capacity

- Strong performance
- Cut speeds of at least 10 inches per minute (IPM)
- Top end of satisfactory cut quality
- Not intended for more than 20% of operating use

Sever Capacity

- Top end of system's capabilities
- Intended only for occasional severance requirements where a lower degree of cut quality is acceptable
- Slower cut speeds

Mechanical Cutting

This process involves the use of physical forces to cut an object. Examples of this type of cutting include sawing, shearing, and drilling. In general, mechanical cutting tools provide excellent cut quality, low cost and maintenance, and are very portable. Included in these tools are:

Reciprocating Saws – a narrow but long saw that cuts with a reciprocating (back and forth) motion. It cuts through just about everything short of a rock. It's the go-to tool for remodeling and demolition. Reciprocating saws can cut through lumber even if it's embedded with nails.

Hole Saws – also referred to as hole cutters or hole drill bits – are drill attachments designed for cutting perfectly round holes in a variety of materials. They're used for several applications such as installing drainage pipes, cutting through masonry and creating holes for plumbing.

Annular Cutters – An annular cutter (also called a core drill, core cutter, broach cutter, trepanning drill, hole saw, or cup-type cutter) is a form of core drill used to create holes in metal. An annular cutter cuts only a groove at the periphery of the hole and leaves a solid core or slug at the center.

Band Saws – A band saw can be used to cut curves, even in thick lumber, such as in creating cabriole legs, to rip lumber and to crosscut short pieces. The most common use for the band saw, however, is in cutting irregular shapes. The second most common use is in resawing or ripping lumber into thinner slabs.