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WELDING GUIDE

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WELDING BUYER'S GUIDE

Welcome to the Princess Auto Welding Buyer's Guide!

Our goal is to help you make the right choice for your welding needs. This convenient guide will give you all the information you require to select the right welder for your project. Having a welder in your tool arsenal can greatly assist you in your building and maintenance needs.

We carry a wide selection of welders for every skill level - all at affordable prices, and backed by our Royal Service guarantee. Our comprehensive assortment of accessories will keep you safe, and help get the job done right!

THE WELDING PROCESS

Welding is a process for joining or fastening two pieces of similar metals (workpieces) by melting and fusing 1) the base metals being joined and 2) the filler metal applied. Workpieces are welded together by applying extreme heat, resulting in melting both pieces and the filler metal (rod/wire) to a molten state that cools to form a strong joint. The energy to form the joint between metal workpieces most often comes from a flame (e.g. oxy-acetylene) or an electric arc. Most welding involves ferrous-based metals such as steel and stainless steel. Welding covers a temperature range of 815 to 1,649°C (1,500 to 3,000°F), and is the strongest method for bonding metal to metal. Welding can also be done without the use of a filler metal, by using heat energy alone.

WHAT TO LOOK FOR WHEN CHOOSING A WELDER

Typical Applications:

Consider the most common uses and applications for your welder: construction, farm/ranch, general maintenance/repair, home, autobody repair, etc. Welders are designed for certain applications, depending on rated output, duty cycle and other features. For example, aluminum repairs require either a heavy duty MIG welder with a spool gun, or a TIG welder that can handle different types and sizes (thickness) of metal. Repairing a wrought iron railing can be done using just a stick welder.

When choosing an electric welder, consider the important factors:

What power is available?
Do you have 230V power in your garage or workshop? If not, you will have to limit yourself to a 115V welder. If electrical hook-up is not available, a gas-powered welding generator can supply welding and auxiliary power.

How thick is your base metal?
The thicker the material, the more powerful the welding machine you will need. See the chart guidelines (pages 9-10).

How much will you use your welder?
If you plan to use your welder for long sessions, you should choose one with a high duty cycle. This will allow you to weld for longer periods before the machine needs to stop and cool down. Duty cycle is a rating that indicates how many minutes, out of ten, that a welder can produce its maximum output without overheating.

What materials will you be welding?
Remember that flux-core wire and most small rods for 115V stick welders only work on mild steel. If you plan on welding aluminum or stainless steel, you must buy a mIG or 230V arc (stick) welder. 230V arc welders can also weld with other specialty rods such as cast iron, hard facing, cutting, and machinable rods.

COMMON WELDING PROCESSES

SHIELDED METAL ARC WELDING (SMAW) – STICK

Welding skill level: moderate

This process uses a consumable electrode to support the arc. Shielding is achieved by the melting of the outer flux coating on the electrode. Filler metal is obtained from the elctrode core.

- Good for windy, outdoor conditions
- OK to use on dirty or rusty metal

Recommended metal:

- Steel, stainless steel, cast iron

Standard Arc Welding Rods

- E6011 - easy to use all-purpose rod with good penetration, even with dirty base metal - mild and medium carbon steels
- E6013 - general purpose all-position rod with low spatter produces a better, cleaner weld
- E7014 - all-position rod with a high deposition rate for faster welding
- E7018 - low hydrogen rod produces tough, high strength welds

Required Equipment:

- Welding helmets
- Leather gloves/protective clothing
- Electrodes: rods

GAS METAL ARC WELDING (GMAW) – MIG

Welding skill level: low to moderate

A process used with a wire-fed welding machine. Metals are joined by heating them with an arc, which is between the continuously fed filler metal electrode (solid wire) and the workpiece. Externally supplied gas or gas mixture provide shielding.

- Easy process to learn
- Better control on thinner metals
- Cleaner welds with less slag to clean
- Equipment can be used for flux-cored welding

Recommended metal:

- Steel, stainless steel, aluminum, cast iron

MIG Wire

MIG wire requires different shielding gases depending on the type of wire being used. Most MIG wires are available in 0.024 in., 0.030 in. and 0.035 in. diameters.

- E70S - mild steel MIG Wire - 75% Argon, 25% CO2
- E316 - stainless steel MIG Wire - 75% Argon, 25% CO2
- E4043 - aluminum MIG Wire - 100% Argon

Required Equipment:

- Welding helmet
- Leather gloves
- Electrodes: rods, flux-cored wire or MIG wire
- Gas hose
- Gas regulator
- MIG shielding gas

FLUX-CORED ARC WELDING (FCAW) – GASLESS

Welding skill level: low

A process that uses a wire-fed welding machine. Metals are melted and joined by heating them with an arc between a continuous, consumable electrode wire and the workpiece. The weld is tubular with flux material contained inside the shielding. Added shielding may or may not be supplied from external gas or gas mixture, depending on the type of flux-cored wire being used.

- Works well on dirty or rusty material
- Deep penetration for welding thick sections
- Can be used with or without shielding gas
- Self-shielded wire is best for outdoors and windy conditions
- Flux-cored wire produces shielding gas when the flux inside the wire melts

Recommended metal:

- Steel, stainless steel

Standard Flux Core Wire

- E71T- flux-cored wire is available in 0.030 and 0.035 diameters

Required Equipment:

- Welding helmet
- Leather gloves/protective clothing
- Electrodes: flux-cored wire

GAS TUNGSTEN ARC WELDING (GTAW) – TIG

Welding skill level: high

This process uses welding equipment with a high-frequency generator. The arc is created between a non-consumable tungsten electrode and the workpiece. Filler metal may or may not be used, and argon inert gas or intert gas mixtures are used for shielding.

- Provides high-quality, precise welds
- Highly aesthetic weld beads

Recommended metal:

- (AC TIG): Aluminum, magnesium alloys, (DC TIG): Steel, stainless steel, copper, brass, and titanium
- Standard TIG welding rods
- EWTh-2 - All-purpose rod for welding steel and stainless steel
- EWCe-2 - General-purpose rod for low amperage welding

Required Equipment:

- Welding helmet
- Leather gloves/protective clothing
- Electrodes: TIG rods, tungsten rods
- Gas hose
- Gas regulator
- TIG gas (typically pure argon or an argon mix) shielding gas
- Optional foot pedal

MULTI-PROCESS WELDERS

A welder that does more than one process. Some do TIG, stick, and MIG, while others do TIG and stick. Multi-process welders offer you the most bang for your buck and they don't compromise on power. Ideal for the hobbyist, do-it-yourselfer, or small contractor who wants to do MIG welding and more, including stick, TIG and flux-cored welding. An efficient and easy way to have all common welding processes in one compact unit. Great for all skill levels as the machines are extremely user friendly and can do the whole range from simple to advanced welds.

INVERTER WELDERS

All Pro.Point welders are inverter welders

Traditional welders use electrical transformers to distribute the current, but inverter welders use computerized circuit board technology to efficiently amplify and distribute input energy to produce the desired welding current. The input is AC current, but the output is DC current to achieve a better weld. Inverter technology allows for lighter, smaller machines, with more power and better efficiency. A superior technology that is typically slightly more costly than a traditional welder, but well worth the investment.

PLASMA CUTTING

Welding skill level: low

Plasma cutters are ideal for cutting and fabricating metal – from thin sheets, to thick beams. Plasma cutting employs a torch, which uses a powerful electric arc to create plasma, made by boosting a gas (nitrogen, argon or oxygen) to a very high temperature. This creates a stream, or cone, of directed plasma that can reach a temperature of 16,650°C (30,000°F). Handheld torches can usually cut up to 1/2 in. (13 mm) thick steel plate, and stronger computer-controlled torches can pierce and cut steel up to 12 in. (300 mm) thick. Unlike laser cutting, for example, the process of plasma cutting is only effective on materials that conduct electricity.

Recommended metal:

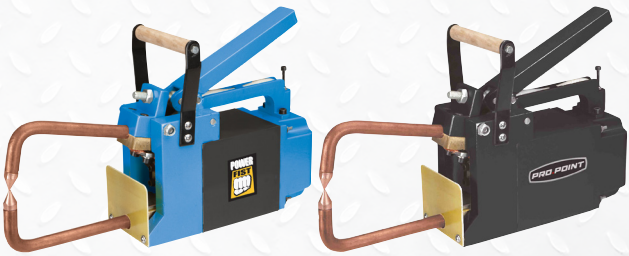
- Any conductive metal - mild steel, aluminum and stainless steel are some examples
- With mild steel, operators will experience faster, thicker cuts than with alloys

Required Equipment:

- Welding helmet or welding goggles
- Leather gloves/protective clothing
- Air compressor

RESISTANCE SPOT WELDING (RSW)

Welding skill level: low



Two separate pieces of metal are joined by passing a current between electrodes positioned on opposite sides of the workpieces. No arc is used; rather, it is the resistance of the metal to the current flow that fuses the pieces.

- Portable and easy to operate
- Ideal for light industrial applications

Recommended metal:

- Steel, stainless steel

Required Equipment:

- Welding helmet or welding goggles
- Leather gloves/protective clothing

OXY-ACETYLENE

Skill level: low to moderate

Torch Outfits

Oxy-acetylene torch outfits use oxygen and acetylene gas to create a portable heat source. They can be used for welding, brazing and cutting.

Welding and Brazing

Welding or brazing rods are melted by the oxy-acetylene torch to create strong metal bonds. One advantage of brazing is that a wide variety of metals can be joined with theis process including: brass, copper, bronze, aluminum and chrome-plated metal. Also, brazing can be done at a lower temperature than welding, which reduces the risk of warping the base metal.

Cutting

Torch cutting is very useful, especially when cutting elaborate shapes not suitable for cutting with a band saw. Only metals that can rust, or be oxidized (typically steel) can be cut with a cutting torch.

Required Equipment:

- Goggles (shade # 5 lens)
- Leather gloves
- Oxygen gas tank
- Acetylene gas tank
- Oxygen and acetylene gas regulators
- Double line hose

Brazing and welding only

- Brazing or welding rods
- Brazing flux (for uncoated rods)

APPLICATION CHARTS

ARC WELDING ELECTRODE USAGE CHART

Electrode (rod)	DC*	AC	Position	Penetration	Notes	Metals
E6010	DC+	--	All	High	Minimum preparation with rough, high spatter	Mild steel with moderate surface contaminants, galvanized steel
E6011	DC+	Yes	All	High		Sheet metal (mild steel), galvanized steel
E6013	DC+, DC-	Yes	All	Low	General purpose, low spatter	Sheet metal (mild steel)
E7014	DC+, DC-	Yes	All	Medium	Smooth, great for beginners, low spatter	Sheet metal and fillet welds
E7018, E7018 AC	DC+	Yes	All	Low	Low hydrogen, strong weld, low spatter	Low alloy steel
E308L	DC+	Yes	All	High	Increased corrosion resistance	Stainless steel
E4043	DC+	--	All	High	Decreased weld cracking	Aluminum
E312-16	DC+	Yes	All	Medium	Universal electrode, crack resistant, strong weld	All steels, or for joining dissimilar steels

* DC+ = electrode positive (Reverse Polarity);
DC-= electrode negative (straight polarity)

ARC WELDING AMP RANGE CHART				
Electrode (rod)	Diameters (inches)			
	1/16	3/32	1/8	5/32
E6010	--	40 - 85	75 - 125	110 - 165
E6011	20 - 30	40 - 85	75 - 125	110 - 165
E6013	20 - 45	40 - 90	80 - 130	105 - 180
E7014	35 - 60	80 - 125	110 - 165	150 - 210
E7018	30 - 50	65 - 100	110 - 165	150 - 220
E7018 AC	30 - 50	65 - 100	110 - 165	150 - 220
E308L	--	40 - 70	--	--
E4043	--	--	70 - 120	--
E312-16	--	50 - 80	80 - 120	100 - 160

MIG WELDING WIRE THICKNESS CHART							
	Solid MIG Wire (in.)				Flux-Core Wire (in.)		
Material Thickness	.024	.030	.035	.045	.030	.035	.045
24 gauge (.025 in.)	■	■					
22 gauge (.031 in.)	■	■			■		
20 gauge (.037 in.)	■	■			■	■	
18 gauge (.050 in.)	■	■	■		■	■	
16 gauge (.063 in.)		■	■		■	■	■
14 gauge (.078 in.)		■	■	■	■	■	■
1/8 in. (.125 in.)		■	■	■		■	■
3/16 in. (.188 in.)			■	■		■	■
1/4 in. (.25 in.)			■	■			■
5/16 in. (.313 in.)			■	■			■
3/8 in. (.375 in.)			■	■			■

TIG WELDING TUNGSTEN ELECTRODE USAGE	
Type of Tungsten	Uses and Performances
Pure	Good arc stability for AC welding. Reasonable good resistance to contamination, Lowest current carrying capacity. Maintains balled end.
Thoriated (Th021) 1.7% - 2.2%	Easy arc starting. High current capacity. Greater arc stability. High resistance to weld pool contamination. Difficult to maintain balled end on AC.
Ceriated (Ce02) 1.8% - 2.2%	Similar performance to thoriated tungsten. Easy arc starting, good arc stability and long life. Possible substitute for thoriated.
Lanthanated (La203) 1.3% - 1.7%	Similar performance to thoriated tungsten. Easy arc starting, good arc stability and long life. High current capacity. Possible substitute for thoriated.
Zirconiated (Zr02) 0.15% - 0.40%	Excellent for AC welding due to favourable retention of balled end. High resistance to contamination, and good arc starting. Preferred when tungsten contamination is intolerable.

METAL TYPE PROCESS CHART					
Metal Type	ARC (stick)	MIG/ Flux	AC-TIG	DC-TIG	Plasma
Steel	X	X		X	X
Stainless	X	X		X	X
Aluminum		X	X		X
Cast Iron	X				X
Copper, Brass		X		X	X
Titanium			X	X	X
Magnesium Alloys					X
Skill level	Moderate	Low	High	High	Low

GLOSSARY OF WELDING TERMS

Arc [Arc Length] - The physical gap between the end of the electrode, and the point where the arc makes contact with the base metal.

Brazing - A group of welding processes in which a groove, fillet, lap, or flange joint is bonded by using a non-ferrous filler metal having a melting point above 427°C (800°F), but below that of the base metals. Filler metal is distributed in the joint by capillary attraction.

Braze Welding - A method of welding by using a filler metal that liquefies above 450°C (842°F) and below the solid state of the base metals. Unlike brazing, the filler metal in braze welding is not distributed in the joint by capillary action.

Butt Welds - A welding technique where two pieces of metal are joined in the same plane.

Chamfer - A transitional edge, usually at a 45° angle. Also known as a bevel.

Duty Cycle - The time per weld out of a 1-minute period that an arc welder can be operated at maximum rated output. For example, a 60% duty cycle @ 300A means that the welding machine can weld for 36 seconds (at 300A) and then must be allowed to cool with the fan running for 24 seconds. This reduces the chance of heat damage to the system.

Electrode - A coated metal wire having the same composition as the material being welded. It can be of stick or wire spool type.

Electric Arc - Electrical conduction that occurs when a strong current jumps a gap in a circuit.

Fillet Weld - Joins two surfaces at an approximate right angle to each other. There are several types of fillet weld.

Filler Metal - A metal added in the making of a joint through welding, brazing, or soldering. Four types of filler metals exist –covered electrodes, bare electrode wire or rod, tubular electrode wire, and welding fluxes.

Flux - The coating on arc welding rods and in flux-cored welding wire that is consumed in the arc to produce a shielding gas. The gas displaces air and impurities from around the weld.

Groove Weld - A weld between the existing preformed grooves in pieces being joined.

Ground Lead / Workpiece Lead - The conductor cable or electrical conductor between the arc welding machine and the work.

Non-Ferrous Metals - Any metal, including alloys, that does not contain iron in appreciable amounts. Generally more expensive than ferrous metals.

Polarity - Polarity is the direction electric current flow. With straight (DC-) polarity, heat is greater at the workpiece, which increases penetration. With reverse polarity (DC+) heat is greater at the electrode, which provides a steadier arc. Reverse polarity is better for making out-of-position welds.

Rated Output - The amperage and voltage the power source will produce for a given duty cycle period. For example, 300A, 32 load volts @ 60% duty cycle.

Shielded Gas - Protective gas used to prevent atmospheric contamination of the weld pool. Usually a mixed gas or C02.

Slag - A layer of flux soot protecting the weld from oxides and other contaminants while the weld is solidifying (cooling). Slag is to be removed after cooling.

Spatter - Metal particles thrown from the weld. often cooling and hardening on the work surface. A spatter-resistant spray applied to the workpiece can minimize spatter.

Torch - A device in the TIG process to control the position of the electrode, to transfer urrent to the arc and to direct the flow of shielding gas.

Tungsten - A rare metallic element with extremely high melting point used for manufacturing TIG electrodes.

Welding Position - All welding can be classified according to the position of the workpiece, or the position of the welded joint on the plates or sections being welded. Some welding processes have all-position capabilities, while others may be used in only one or two positions. The 4 basic weld positions are: flat, horizontal, vertical, and overhead.

Wire Feed - Motor driven deck which feeds welding wire through the welding nozzle.

Wire Feed Speed - Expressed as in./min. or mm/sec, and refers to the speed and amount of filler metal fed into a weld. The higher the wire feed speed, the higher the amperage.

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Visit **princessauto.com** to see our full line of welding equipment, plasma cutters, and accessories.