



Welding Basics

The Orion is a true micro pulse arc welder. It is also a capacitive discharge resistance welder. This combination of abilities allows for infinite creative possibilities. The Orion can be used as a tack welder to temporarily position parts before welding or soldering. By increasing the power output it can also be used as a permanent fusion welder (resistance welder, spot welder). In its pulse arc setting the Orion can be used to perform permanent welds, add metal, and do a variety of other amazing and time saving applications.

What is a Pulse Arc Welder?

A pulse(d) arc welder is a special case of a Tungsten Inert Gas (TIG) welder. In TIG welding a sharpened tungsten electrode is used in combination with electrical power to start and sustain an high temperature plasma stream - an arc. This plasma arc is used as a heat source to melt the work piece metal. Filler metal can also be added to build up joints and create strong and reliable weld “bead” or weld seams.



TIG welders can use AC or DC energy to initiate the plasma arc. Sunstone Engineering has chosen to build on our extensive experience with DC welding technology. The Orion uses industrial capacitive discharge technology to produce both the pulse arc weld. AC wall voltage can vary up to 20% during the day. Capacitive welders have the advantage over AC technologies of precisely storing energy before the welding process. This means that the Orion will produce a repeatable weld independent of AC power fluctuations.

The Orion pulse arc welder is a micro TIG welder and allows extremely fine control over all welding parameters. This control allows everything from ring re-tipping to seam welds in moderately sizes steel work pieces. Combine the Orion’s simple and user friendly LCD interface with its advanced features make ideas come to life.

What is resistance welding (also called tack, fusion and spot welding)

Resistance welding, often called tack or fusion welding in the jewelry industry, takes place using a very different process from that of TIG welding. In resistance welding a large electrical current is passed through two work pieces to join them. At the contact point between the two materials there is a resistance to the flow of

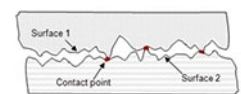


Figure 2: On the micro-scale, surface roughness limits surface-to-surface contact. More contact points result in a lower contact resistance.

the electrical current. As electrical current is passed through this contact point resistive heating takes place. When enough current passes through the work pieces the temperature (especially at the interface between the two pieces) can become hot enough to melt the metal in a spot. The terms resistance welder and spot welder are descriptive of this process.

If you limit the amount of power and electrical current going into the weld you can create a temporary or weak weld called a “tack” weld. Tack welding is very useful in jewelry making. It provides the ability to temporarily position a part before permanent welding. This ability opens a multitude of creative possibilities. It also helps eliminate the need for complicated binding or clamping of parts before permanent welding or soldering.

Permanent resistance welding is also useful in jewelry making. The Orion can weld ear posts and wires, tie tacks, catches, domed parts, joints pins, bolo backs and much more. Because the heart of the Orion is also an industrial capacitive resistance welder numerous everything from one time pieces to production welding is possible.

Why is protective welding gas necessary?

During the pulse arc welding process high temperature plasma quickly melts metal into a molten pool at the weld location. If room air is allowed to come into contact with the molten metal, oxygen from the air will quickly react with the hot metal. The result is an metal oxide that is brittle, porous and burnt looking.



If we use a protective weld gas, such as pure Argon (99.9% pure, Argon 4.6) we can prevent these effects. The argon is used to displace any oxygen at the weld location. As the arc performed the protective gas acts as a barrier to prevent oxygen from entering the weld zone. After the weld has cooled the protective gas is turned off.

Using the Orion pulse arc welding stylus

The Orion pulse arc welding stylus has been designed for ease of use. Touch the stylus electrode gently and lightly to the weld surface. In automatic trigger mode the Orion will then start the welding process for the user by pre-flowing protective gas (argon). Just before the Orion is about to make a weld it will sound an audible beep alert. Removing the electrode from the work piece before or during this beep will abort the welding process. If the weld is allowed to continue the arc will be initiated. During the welding process the stylus electrode is automatically retracted to prevent electrode contamination of the work piece.



Most users can become proficient on the Orion pulse arc welding stylus after a few minutes of practice. We recommend performing a series of practice welds on some stainless steel or titanium material (or what ever is available). These welds will help the new user learn the tip pressure requirements, the use

of gas flow, and a range of power settings available. In the Orion Master Jeweler Plus the user can select a tip retract preference to better match contact pressure preference.

During welding your hands should be kept steady. Shaky hands may distort the finish of your weld. Rest your hands on a surface to We highly recommend a pulse arc welding stylus stand or the use of the stereo-microscope to help overcome shaky hands.

Practical considerations before welding

To help make your welding project successful we recommend that you consider and follow these steps:

1. Consider the physical properties of the materials to be welded
2. Practice welding on a parts with similar size and composition (until you feel comfortable)
3. Consider the joint and part to be welded
4. Use the Metal Information Table as a guide

Consider physical properties

Different metals and alloys can respond quite differently during the welding process. To help determine the correct starting parameters it is helpful to understand some physical properties associated with the metal. For example does this material conduct heat away quickly (high thermal conductivity). If so you may need to start with more energy to get the same spot size as a less conductive material. Does the material have a low melting temperature? If so you may need to turn down the power but extend the time of the weld. Adding to much weld current (directly related to the power setting) to a low melting temperature metal may cause it to vaporize.

After a short time welding on a variety of metals the user will gain an intuition about selecting a weld setting. It is always advisable when welding a new material to start with very low power and work upward as needed.

Practice on similar sized material

Work piece volume can play a large role on weld properties. Practice on a test piece of similar size and geometry to help find the exact settings desired. During your practice welds phase hold the work piece with a welding attachment and not directly with your fingers. This will help you get a feel for the final temperature of the part. The temperature of the work piece will depend of material properties - especially the volume of the work piece vs. the amount of weld energy. If the piece is large its overall temperature will likely stay low, regardless of the weld energy. If the work piece is small and the energy input is small (e.g. micro mode) its temperature will also stay low.

Consider the joint and part to be welded

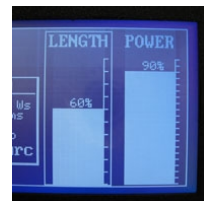
Remember that some materials, such as solder, perform poorly when welded with the pulse arc setting. If your joint contains solder you should remove it prior to welding. If your joint has cracked you may consider adding filler material out past the cracked area to restore metal strength. Consider the type of joint (I, X, V, Y etc.) and plan to use an appropriately sized filler wire if needed.

Metal Information Table

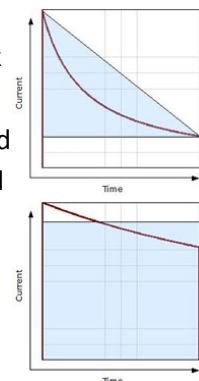
Base Metal	Thermal Conductivity (J/m-sec-deg)	Melting Point (°F)
Chromium	93.9	3407
Copper	401	1981
Gold	318	1945
Nickel	90.9	2647
Palladium	71.8	2826
Platinum	71.6	3217
Rhodium	150	3569
Silver	429	1761
Titanium	21.9	3035
Tungsten	173	6170

Power vs. time adjustment

The Orion Master Jeweler and Master Jeweler Plus allow the user a great deal of flexibility to control the penetration and size of the pulse arc weld spot. The power adjustment control can be generally through of as a control of spot size while the time adjustment can be through of as weld penetration. In addition power can also be considered a measure of welding current and heat. The time can be considered the time that welding current or heat is applied.



Because the Orion is based on a capacitive discharge resistance welder the welding output pulse will have a smooth welding current decay. The pulse will start with a peak current which will decay to a final weld current value. The curve will look very similar to a triangle. If the weld pulse is allowed to decay fully to its low state the actual weld will look smooth. This decay behavior allows the weld pool to solidify more slowly and provides an extremely fine, smooth finish. If the weld pulse (and time) are short the pulse will approximate a square shape. The weld current will rise quickly and stay relatively constant and then stop. This type of square pulse behavior is an excellent



choice when the weld electrode must be placed at a shallow angle. The square pulse (short weld time) provides a stable arc as the weld electrode is retracted.

The welding electrode

The Orion pulse arc welding stylus can accept two electrode diameters, 0.5mm and 1.0 mm. Weld current is related to the diameter of the welding electrode. For small, low power welds, especially in micro-mode, use 0.5mm electrodes. For welds all the way from the low to high power the 1.0mm electrode is preferred.

