AC Aluminum Pulse (GMAW) Weld Process Guide

Overview

AC Aluminum Pulse for superior quality welding*.

- **Increases travel speed up to 40%**
- **Increases deposition up to 75%**
- **Decreases burnthrough**
- **Improves gap bridging**

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*Based on a side by side comparison of AC Aluminum Pulse and Pulse.

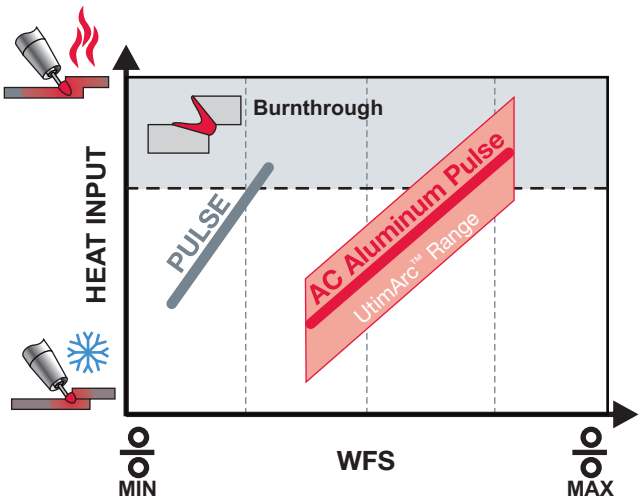
AC Aluminum Pulse Details

Process Description

AC Aluminum Pulse (GMAW) brings features that cannot be realized with standard DC pulse MIG welding. The AC pulse process reduces the heat input by focusing the energy away from the base plate and switching the polarity of the arc.

Productivity increases with improved deposition rates using **AC Aluminum Pulse** (GMAW) waveform technology are available exclusively on the Power Wave® Advanced Module. This is possible because the **negative polarity** arc redirects the heat away from the workpiece, reducing the chance of burnthrough. The UltimArc™ and synergic precision controls give the user full control over heat input, penetration while improving cleaning action, and allowing for faster travel speeds on thin material.

With this technology, it is now easier to weld thin aluminum and bridge gaps. Precise control of the heat input is achieved with the UltimArc™ control using **AC Aluminum Pulse** (GMAW). UltimArc™ adjusts the amount of DC negative time during the background to allow less heat to be transferred to the workpiece.



Waveform

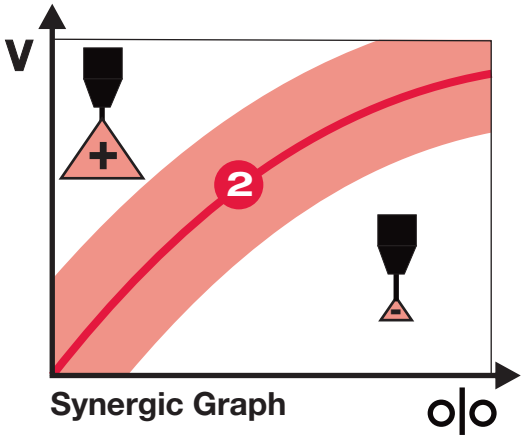
Peak
Propels droplet toward the weld pool.

Positive Background
Completes droplet transfer and begins the creation of the next droplet.

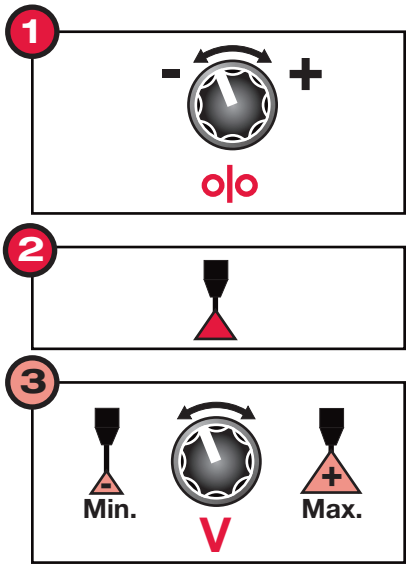
Negative Background
Reduces heat input by redirecting current flow towards the electrode.

AC Aluminum Pulse Optimization

Synergic Welding



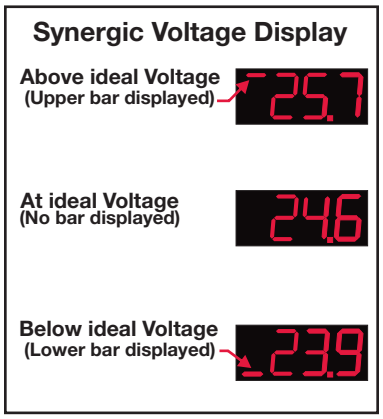
AC Aluminum Pulse waveforms are synergic weld modes. Based on the wire feed speed❶, set by the operator, a pre-programmed voltage is automatically selected❷. Fine tune the arc length using Voltage adjustment❸.



Adjust WFS to the desired setting. Refer to the Application section for the recommended settings.

Based on WFS a preprogrammed nominal voltage is selected.

Adjusting voltage increases or decreases the arc length, allowing the user to fine tune arc characteristics.



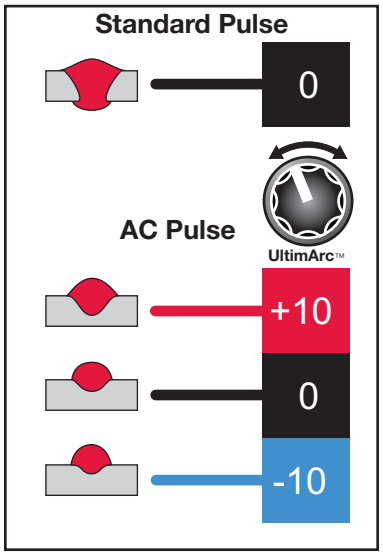
A note on Trim.
Lincoln Electric® developed Trim as a means to simplify the complexities of Arc Length control in advanced welding application set-up, such as Pulse. Now, Lincoln Electric® Synergic Weld modes improve the ease of set-up by preselecting an ideal voltage based on the selected WFS. The user can then fine tune their Voltage setting based on their personal preference and can easily see whether they are above or below the nominal setting.

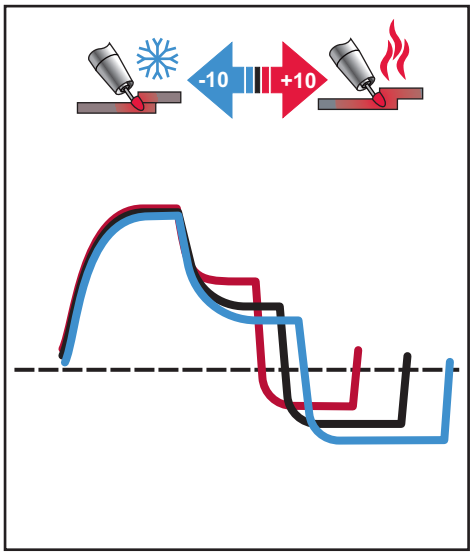
UltimArc™ Control

The **UltimArc**™ control fine tunes the heat input into the plate.

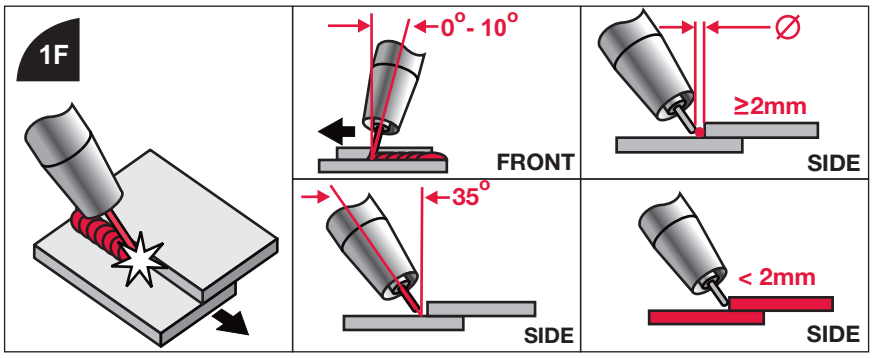
Increasing (+) the setting provides more heat into the weld puddle resulting in a more focused arc.

Decreasing(-) the setting reduces heat directed into the puddle resulting in a less focused arc.





1F / PA Lap Automatic



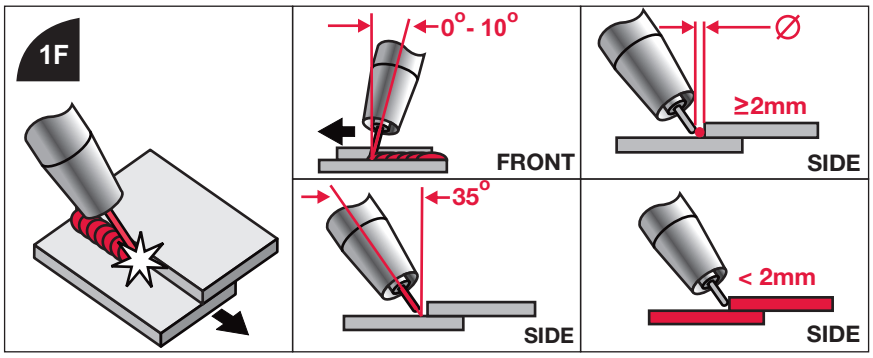
- Use a 0-10° push angle.
- Use a 35° work angle.
- Position the electrode approximately one electrode diameter outside the joint favoring the bottom leg.
- For less than 2mm applications position the electrode directly in the joint or slightly favoring the top edge. May require decreased work angle.

100Ar
1/2 in.

	mm (ga)	in/min	in/min	A	V*	UltimArc™
SuperGlaze® 4043 0.035" (0.9mm)	2.5 (12)	450	35	116	19.0 - 21.0	2.5
	2.0 (14)	375	35	99	18.5 - 20.5	0.0
	1.5 (16)	340	35	91	17.7 - 19.7	0.0
	1.0 (19)	195	20	62	16.7 - 18.7	-2.5
SuperGlaze® 4043 3/64" (1.2mm)	3.0 (11)	400	40	181	19.0 - 21.0	5.0
	2.0 (14)	280	40	132	18.1 - 20.1	0.0
	1.5 (16)	200	35	100	17.0 - 19.0	0.0
	1.0 (19)	120	25	75	16.5 - 18.5	0.0
SuperGlaze® 4043 1/16" (1.6mm)	3.0 (11)	215	40	188	18.8 - 20.8	0.0
	2.0 (14)	140	40	132	18.1 - 20.1	-3.0
	1.5 (16)	110	35	113	17.4 - 19.4	-10.0
SuperGlaze® 5356 0.035" (0.9mm)	2.5 (12)	675	40	145	18.8 - 20.8	10.0
	2.0 (14)	550	40	120	17.8 - 19.8	5.0
	1.5 (16)	425	30	96	16.4 - 18.4	0.0
	1.0 (19)	200	20	54	14.9 - 16.9	-5.0
SuperGlaze® 5356 3/64" (1.2mm)	3.0 (11)	550	45	212	20.0 - 22.0	5.0
	2.5 (12)	425	45	159	17.8 - 19.8	0.0
	2.0 (14)	320	45	132	17.3 - 19.3	0.0
	1.5 (16)	275	40	116	16.3 - 18.3	0.0
	1.0 (19)	125	25	68	15.3 - 17.3	0.0
SuperGlaze® 5356 1/16" (1.6mm)	3.0 (11)	350	40	234	19.2 - 21.2	10.0
	2.0 (14)	175	40	134	16.4 - 18.4	2.5
	1.5 (16)	140	35	109	16.0 - 18.0	-5.0
	1.0 (19)	100	35	86	15.3 - 17.3	-10.0

* Optimal voltage may vary based on cable and torch configuration.

1F / PA Lap Semi-Automatic



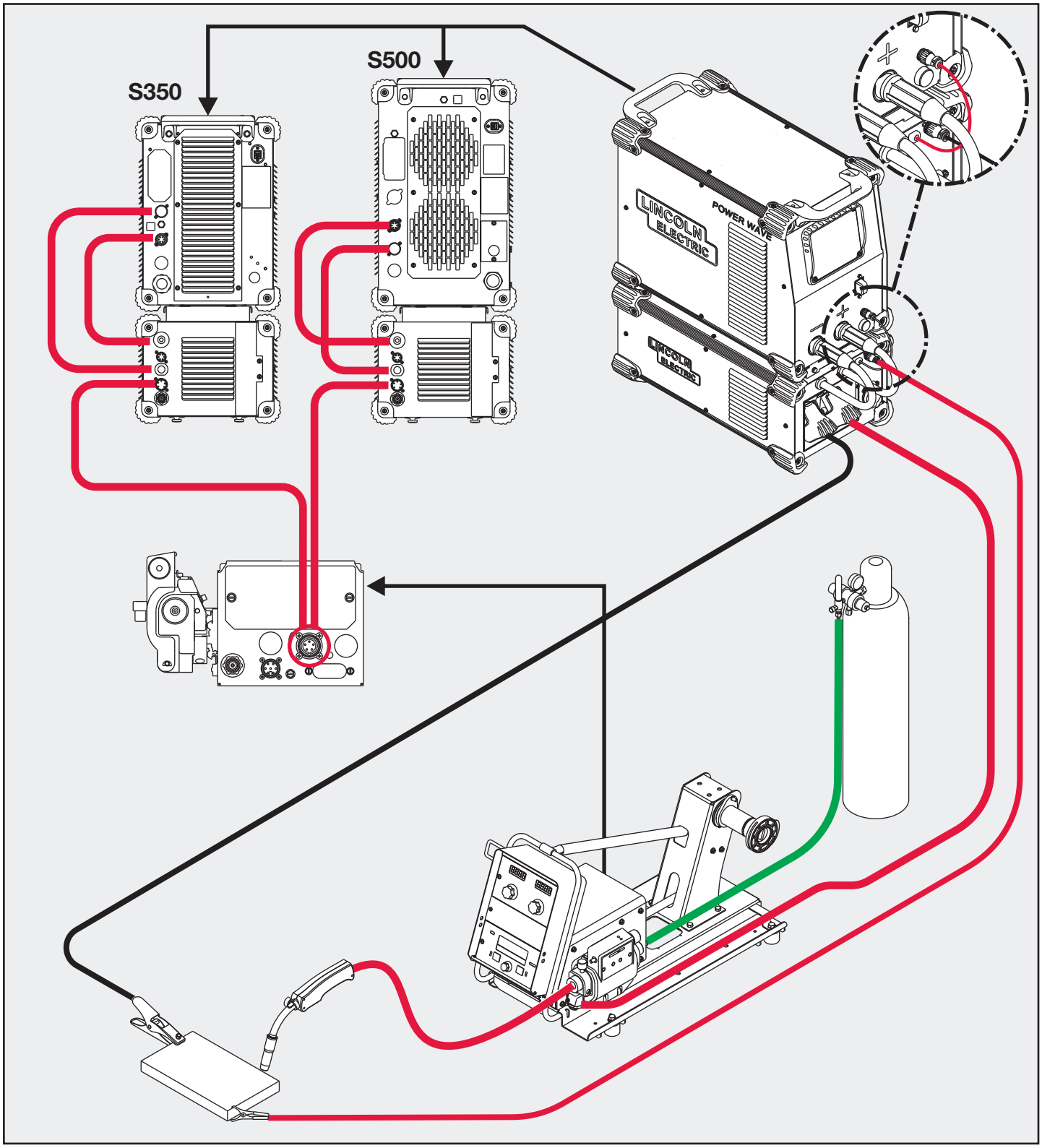
- Use a 0-10° push angle.
- Use a 35° work angle.
- Position the electrode approximately one electrode diameter outside the joint favoring the bottom leg.
- For less than 2mm applications position the electrode directly in the joint or slightly favoring the top edge. May require decreased work angle.

100Ar
1/2 in.

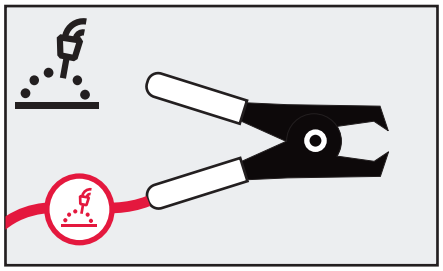
	mm (ga)	in/min	A	V*	UltimArc™
SuperGlaze® 4043 0.035" (0.9mm)	2.5 (12)	465	110	20.4 - 22.4	0.0
	2.0 (14)	390	100	19.5 - 21.5	0.0
	1.5 (16)	300	83	19.0 - 21.0	0.0
	1.0 (19)	155	56	17.5 - 19.5	-5.0
SuperGlaze® 4043 3/64" (1.2mm)	3.0 (11)	300	140	20.5 - 22.5	0.0
	2.0 (14)	210	105	19.2 - 21.2	0.0
	1.5 (16)	175	95	18.7 - 20.7	0.0
	1.0 (19)	110	70	17.9 - 19.9	-5.0
SuperGlaze® 4043 1/16" (1.6mm)	3.0 (11)	150	149	20.5 - 22.5	0.0
	2.0 (14)	115	129	20.0 - 22.0	-5.0
SuperGlaze® 5356 0.035" (0.9mm)	2.5 (12)	525	118	18.4 - 20.4	5.0
	2.0 (14)	460	107	18.1 - 20.1	2.5
	1.5 (16)	365	91	17.2 - 19.2	0.0
	1.0 (19)	200	58	16.3 - 18.3	-5.0
SuperGlaze® 5356 3/64" (1.2mm)	3.0 (11)	400	154	18.5 - 20.5	5.0
	2.0 (14)	275	118	17.9 - 19.9	0.0
	1.5 (16)	210	95	16.7 - 18.7	0.0
	1.0 (19)	120	64	15.3 - 17.3	-5.0
SuperGlaze® 5356 1/16" (1.6mm)	3.0 (11)	245	171	19.6 - 21.6	0.0
	2.0 (14)	125	107	16.9 - 18.9	0.0
	1.5 (16)	100	88	16.7 - 18.7	-10.0

* Optimal voltage may vary based on cable and torch configuration.

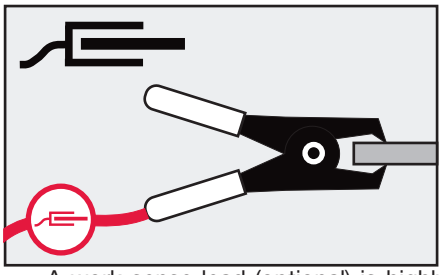
Connection Diagram



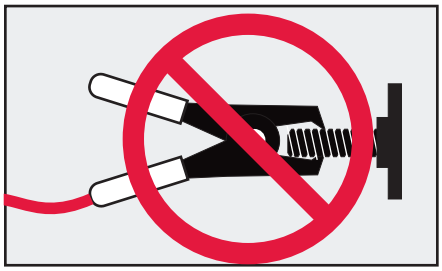
Sense Leads



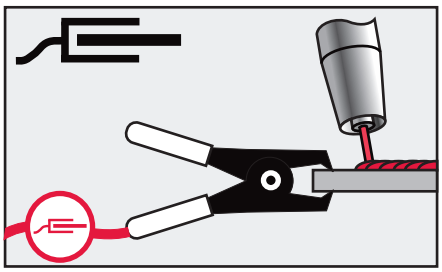
An electrode sense lead is required. This is a standard connection in an Arclink® cable.



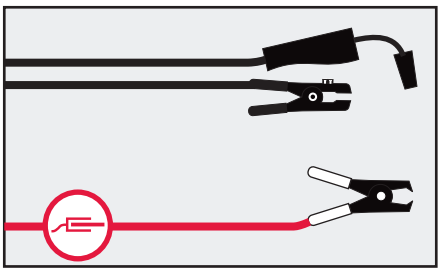
A work sense lead (optional) is highly recommended for total welding cable lengths >50 ft. and should be connected directly to the workpiece.



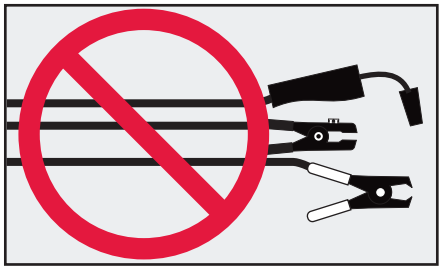
DO NOT connect either sense lead to a welding stud as this may result in erratic arc or increased spatter.



For best performance, connect the work sense lead close to the welding arc.

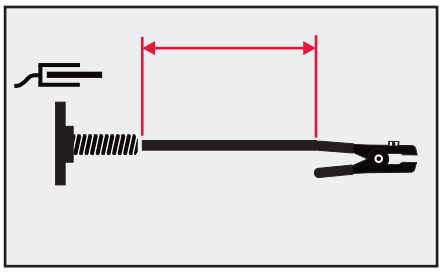


The work sense lead should be separated away from welding cables to minimize interference.

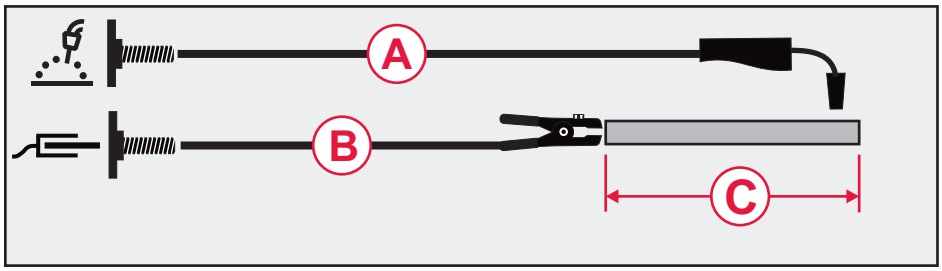


DO NOT route sense lead cable close to high current welding cables as this may distort the sense lead signal.

Work Leads

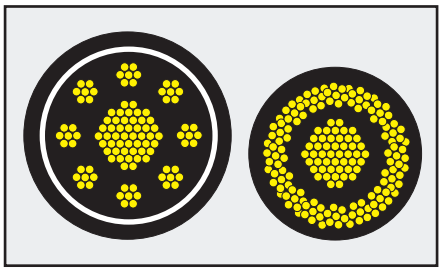


Connect the work lead to the work stud on the module and directly to the work piece. Maintain the shortest connection length possible.

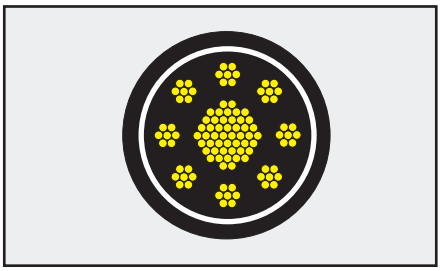


The total length of the welding current loop (A+B+C) should be minimized to reduce inductance.

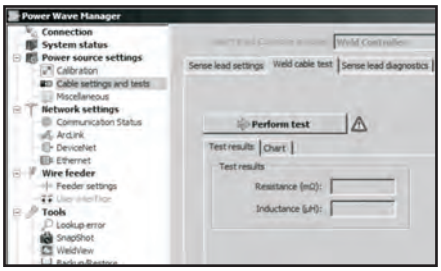
Route cables (A,B) close together to further reduce cable inductance.



For configurations with excessive inductance, use Lincoln Electric® patented coaxial welding cables.



Lincoln Electric® coaxial cables combine the positive and negative welding leads into one cable to minimize cable inductance.



Test cable inductance levels using the Power Wave® Manager software exclusively from Lincoln Electric®.

Troubleshooting

Check	Proper Feeding	Spring Loaded Tip* (5000 Series)	Surface Contaminates	Volts	Travel Speed	Wire Feed Speed	Tip	Electrode Sense Lead
Erratic Arc								
Action	!	!		↑	↓	↓		

* The use of a spring loaded tip is recommended for semi-automatic welding applications using 5000 series electrode.

Check	Volts	Gas Coverage
Fine Spatter		
Action	↓ !	!

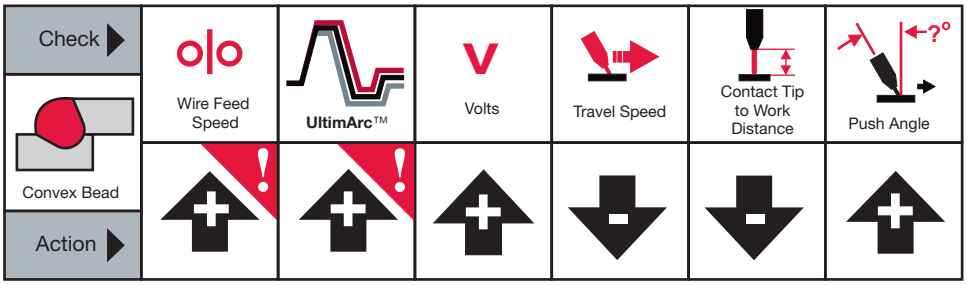
Check	Volts	Travel Speed	Wire Feed Speed	Push Angle	Gas Coverage	Contact Tip to Work Distance
Large Spatter						
Action	↑ !	↓ !	↓	↓		↓

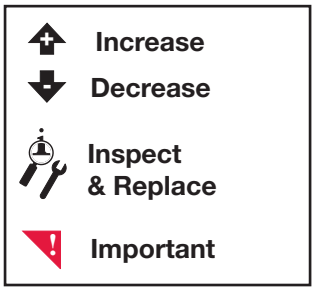
Check	Gas Coverage	Surface Contaminates	Contact Tip to Work Distance	Tip	Travel Speed	Push Angle
Porosity						
Action	!	↓ !	↓		↓	↓

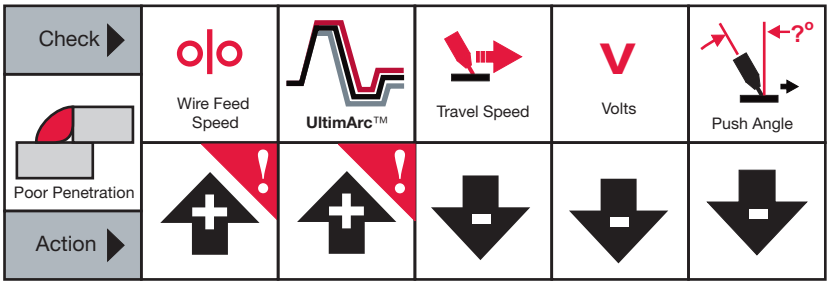
Check	Wire Feed Speed	UltimArc™	Volts	Push Angle
Concave Bead				
Action	↓ !	↓ !	↓	↓

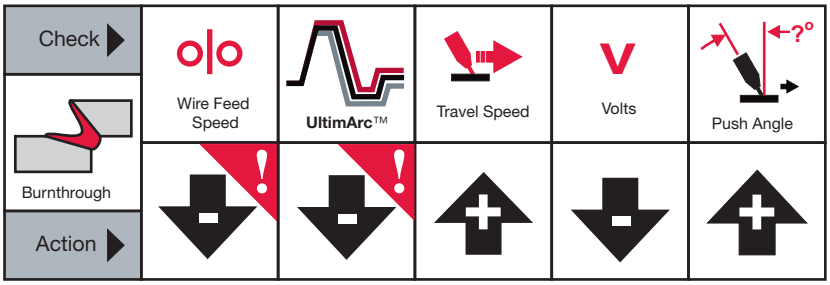
- ↑ Increase
- ↓ Decrease
- Inspect & Replace
- ! Important

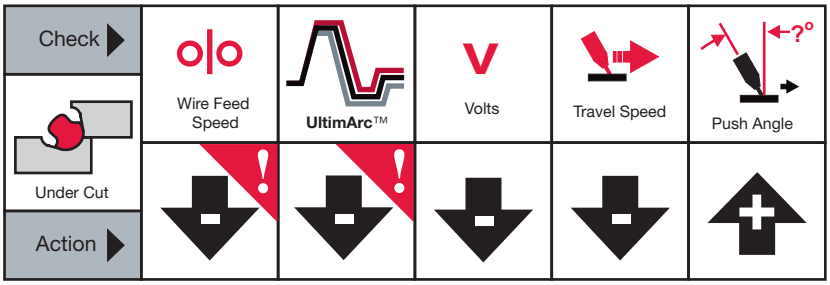
Troubleshooting

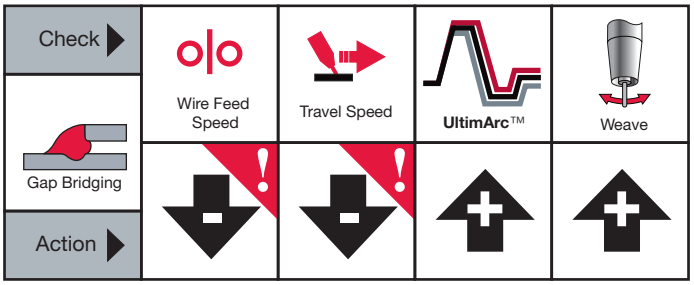




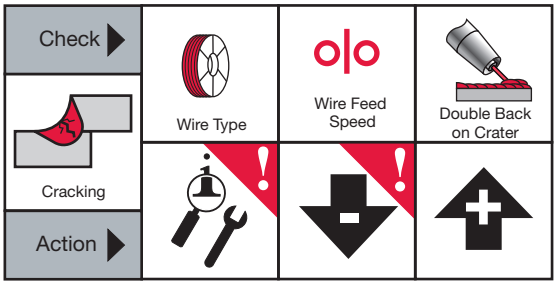


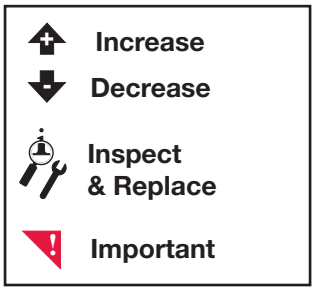


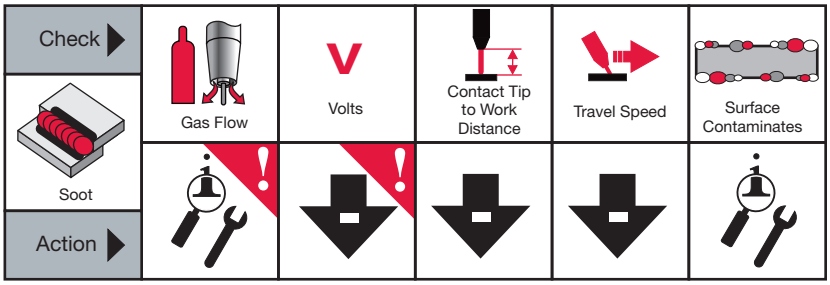


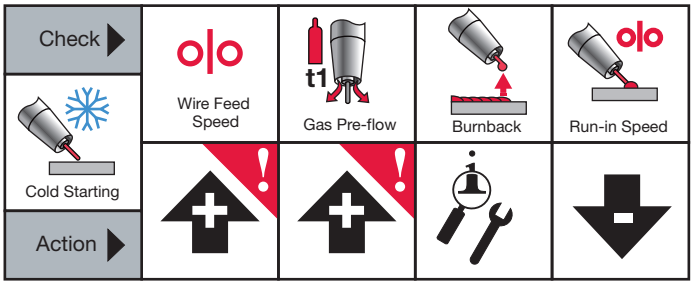


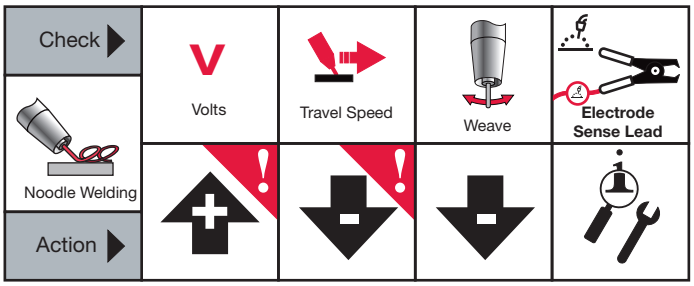
Troubleshooting











NOTES: Aluminum is more susceptable to some issues which can be easily fixed with the right tools.

Arc Wandering - tends to be more prevalent with 5000 series wires. This can be minimized by introducing a Spring Loaded Tip which provides a constent contact point for the current path.

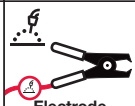
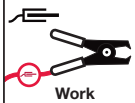
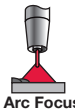
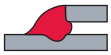
Soot - is undesirable from an appearance standpoint, but can not be completely eliminated. It is important to remember that black soot around the weld bead is acceptable. If soot is present on the weld bead the operator should verify all set-up and procedures. Voltage and gas coverage are two main culprints of this problem.

Erratic Arc Behavior - can be caused from various components in the weld system. It is important to clean gun liners, change contact tips, and check wire tension. Drive rolls should not be overtightened causing the wire to deform as it exits the feeder.

Torch Calibration - Some push pull systems require the operator to verify wire feed speed calibration. Following the torch manufacturers calibration recommendations can prevent major feeeding issues.

AC Aluminum Pulse Glossary

Icons

 Wire Type	 Gas	 Material Thickness	 Wire Feed Speed	 Travel Speed	V Volts	A Amps	T Trim	 Contact Tip to Work Distance	 Arc Length	 Control Knob
 Weld Stud	 Torch	 Electrode Sense Lead	 Work Sense Lead	 Work Clamp	 Torch Nozzle	 Heat Input (High)	 Heat Input (Low)	 Arc Focus (Broad)	 Arc Focus (Narrow)	 UltimArc™
 Stop / Avoid	 Gap Bridging									

Technical Terms

Soot — A black substance which collects near or on the weld bead.

Burnthrough — A hole in the base material caused by excessive heat input during welding.

Cable Inductance — Resistance to change in current.

GMAW — Gas metal arc welding including metal inert gas (MIG) and metal active gas (MAG) welding.

Porosity — Gas entrapped in solidifying metal forms spherical or elongated pores in the weld.

Push Angle — The angle at which the electrode leads the weld pool relative to the direction of travel.

Run-In Speed — A wire feed speed used to establish an arc.

Work Angle — The angle of the electrode, off perpendicular, relative to the work piece surface.

Procedure Notes

All listed procedures are starting points and may require some adjustment depending on the specific application.

Torch angle, electrode placement, contamination, mill scale, joint fit up, and joint consistency are factors that may require special consideration depending on the specific application.

At higher travel speeds, joint fit up, wire placement, and contamination all become factors that are more significant.

The result of welding at higher travel speeds is a tendency to produce more spatter, less penetration, more undercut, and a less desirable bead shape. Depending on the limitations / requirements of the actual application, slower travel speeds and higher arc voltages may be required.

As the travel speed increases in fast follow applications (1/4" to 14 Gauge), a tighter and arc length must be maintained so that the puddle properly follows the arc. Operators typically reduce the arc length control (Trim) to achieve this.

At faster travel speeds, the bead-shape can become very convex (or ropy), and the weld will not "wet" well. There is a point at which the arc is set so short that the arc will become unstable and stubbing will occur. This forms a limitation of just how fast the travel speed can be raised.

It is ultimately the responsibility of the end user to ensure the proper weld deposition rate, bead profile, and structural integrity of a given weld application.

Customer Assistance Policy

The business of The Lincoln Electric Company is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or advice about their use of our products. Our employees respond to inquiries to the best of their ability based on information provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or advice. Moreover, the provision of such information or advice does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or advice, including any implied warranty of merchantability or any warranty of fitness for any customers' particular purpose is specifically disclaimed.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to www.lincolnelectric.com for any updated information.