

PROCESS

LINCOLN[®]
ELECTRIC
THE WELDING EXPERTS[®]

WAVEFORM CONTROL TECHNOLOGY[®]

TOTAL s2f™ Semiautomatic Aluminum MIG Welding Solutions

Welding aluminum is different than welding steel. Those who have done both will readily acknowledge this fact. Until recently, welding power supplies were controlled by analog circuitry and were optimized for only one task, usually GMAW using carbon steel. Everything else was a compromise. If they welded aluminum well, it was usually a fortunate coincidence. Moreover, since these power supplies were controlled by analog circuitry, the only way to change the machine's welding characteristics was to change circuitry. Some equipment required hardware changes, new circuit boards, rewiring or even a new power source! Although this was not always the best solution for individual customer's needs, it was a reality of the technology of the times.

More recently, welding power supplies have become software-controlled digital systems. This has led Lincoln Electric[®] to the development of ArcLink[®] Power Wave[®] multi-process power sources. This platform provides the user with a premier welding package and allows for improved delivery of waveforms associated to steel, aluminum, and a variety of other material types.



TOTAL s2f™ Aluminum Welding Solutions from Lincoln Electric[®]

Providing a complete answer to your aluminum MIG welding needs from "start 2 finish".

- Power MIG[®] and Power Wave[®] welding systems provide the best equipment for light and industrial aluminum welding needs.
- Super Glaze[®] aluminum consumables deliver consistent wire composition, smooth feeding, and a stable arc.
- Nextweld[®] welding processes beat all of the challenges you face with aluminum welding.

a d v a n t a g e s

MORE CONSISTENT STARTING BEHAVIOR

- Lower run-in wire feed speed for softer starts.
- Adjustable start controls to improve starting in thick or thin aluminum.
- Controlled conditioning of the wire end to promote positive starting.

REDUCED SPATTER LEVELS AND IMPROVED CLEANING ACTION

- New Pulse and Pulse-On-Pulse[®] Waveforms have been softened to create better cleaning, reduce spatter, improve bead shapes and provide a more pleasing arc sound.

BETTER AND MORE CONSISTENT CRATER FILLING

- Controlled wire feed speed and trim ramp time fills and caps the crater to help prevent crater cracks.

SYNCHRONIZED END PULSE

- A great start depends on a great finish. A controlled, synchronized end pulse at the end of each weld cycle provides a consistent wire tip geometry for great arc starting.

The future of welding is here. [®]

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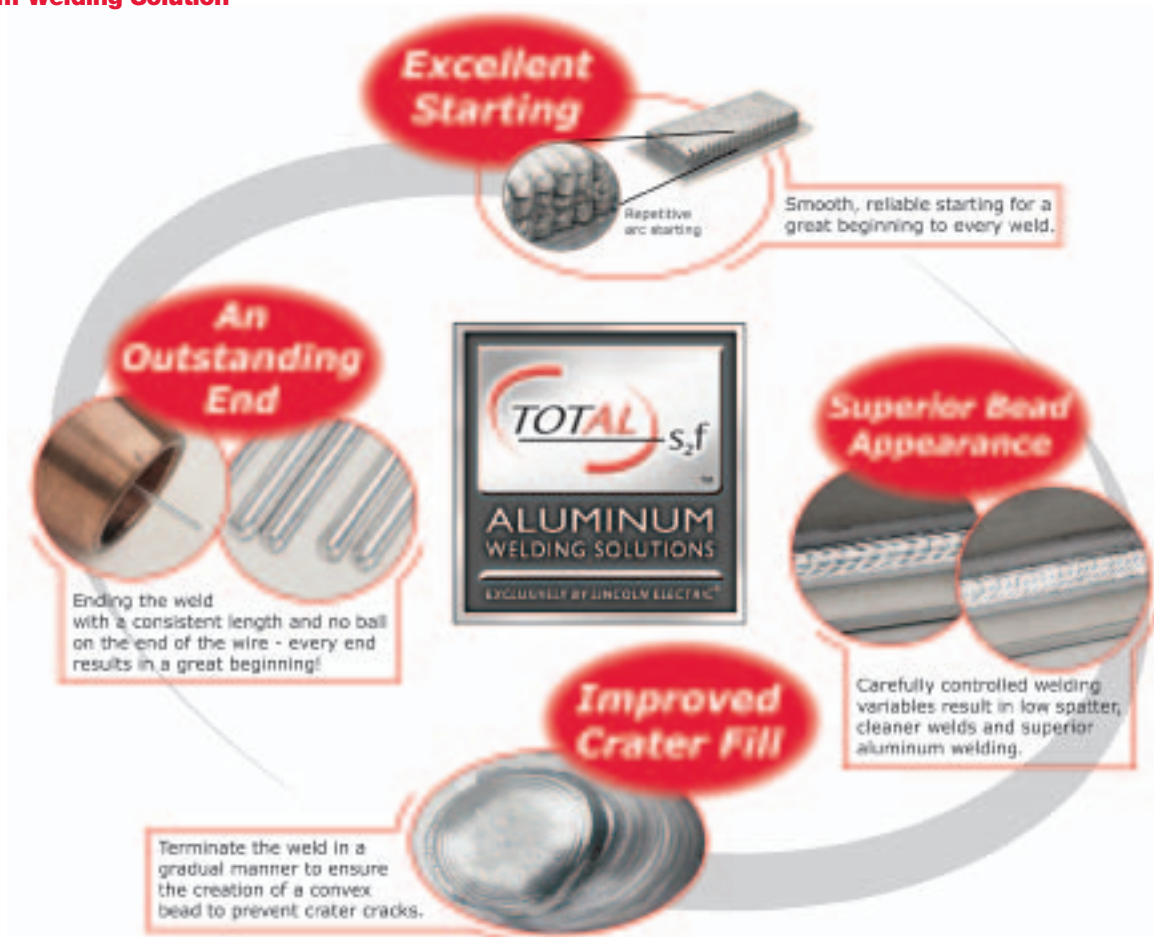
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TOTAL s2f™ Semiautomatic Aluminum MIG Welding Solutions

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The TOTAL s2f™

Aluminum Welding Solution



The TOTAL s2f™ process is the complete aluminum welding solution. This aluminum welding process focuses on the details from the start to finish of every weld. The TOTAL s2f™ solution delivers a soft aluminum arc, consistent conditioned starting and ending, plus improved cleaning action for a superior weld on tough aluminum jobs.

The TOTAL s2f™ solution is the answer.

How

Does TOTAL s2f™ Solution Change the Way Aluminum is Welded?

The Lincoln Electric Power Wave® 355M, 455M, and Power MIG® 350MP™ power supplies are the premium and most advanced examples of digital power supplies in the marketplace today. The fact that they are software-controlled means the end user doesn't have to compromise finished weld quality any longer.

The result is an optimized start, weld, crater, and end which provides the best welding solution for each application. Lincoln Electric's TOTAL s2f™ aluminum welding process delivers a major improvement in aluminum welding, especially for the thinner aluminum

base material where pulsed spray welding is most advantageous. TOTAL s2f™ process technology will make aluminum welding significantly easier and more consistent. The newer aluminum waveforms are included standard on a range of power sources for a wide variety of aluminum applications. Lincoln Electric® has a package suited for all customer and application needs: the Power MIG® 300 and 350MP for small to medium fabrication, the Power Wave® 355M for medium to large production, and the Power Wave® 455M or 455M/STT™ for heavy duty, large production semiautomatic or automatic welding.

What Improvements

Have Been Made?

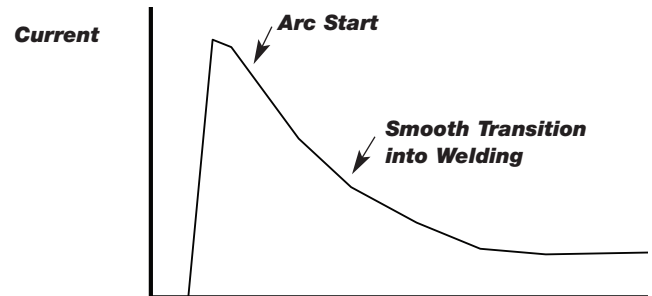
Better Starting

By far, a nice, soft arc start is preferred when welding aluminum. The soft arc start tends to be more robust, more consistent, produces less spatter, and almost seems to grow out of the plate.

Slow run-in wire feed speed (WFS) has traditionally been used to soften the arc start. This feature was enhanced by lowering the run-in capability to 30 in./min. (76.2 cm/min.) in the Power Wave® and Power MIG® which is beneficial to give good, smooth starts with no popping or small pieces of wire being expelled. The lower run-in speed also results in better, more consistent starts, especially with larger diameter wires like 1/16 in. (1.6 cm). The Power Wave® and Power MIG® systems offer additional flexibility by allowing waveform parameters to be set to meet requirements in the field.

Aluminum requires high currents to reliably start large diameter wires, especially 1/16 in. (1.6 cm) 4043. The Lincoln Electric® Power Wave® will readily supply this current. For example, the Power Wave® 455M or 455M/STT can provide starting currents over 750 amperes.

With the TOTAL s2f™ aluminum welding process, the most important element of good starting is the condition of the end of the wire. Short of cutting the wire each time, the best results are obtained when there is not a large ball on the end of the wire. The condition of the end of the wire is a result of the end of the last weld. The TOTAL s2f™ welding waveforms provide a quality end to the weld by delivering one last droplet before shutting off the welding current to deliver a consistently clean wire end each time. The sharp, consistent end delivers a good start to the next weld every time.



Separate Start Controls

There is a separate start function that is available from 0 to 10 seconds (in 0.1 second increments) after the arc is struck. During this time, the **starting** WFS and trim can be adjusted independently of the **welding** WFS and trim. Set higher, the start WFS acts as a hot start. If the welding WFS is set at 200 in./min. (508 cm/min.) and the start WFS is set at 350 in./min. (889 cm/min.), the slow run-in will start the wire slowly, the arc will strike, and the start WFS will come on at 350 in./min. (889 cm/min.) The start WFS will then ramp down over the start time, to the welding WFS. This is particularly effective when welding thicker aluminum to heat the work piece quickly and minimize the build-up at the weld start.

Alternatively, for thin aluminum, it is recommended to set the start WFS approximately 100 in./min. (254 cm/min.) lower than the welding WFS. It will ramp up to the welding WFS over the start time (0.5 – 1.0 seconds is recommended) and give a smooth start with little or no build-up at the weld start.



Power Feed™ 10M Mode Select Panel (MSP4)

Improved Cleaning Action and Reduced Spatter

With the Power Wave® and Power MIG® digital platform, there is control over twenty welding variables in pulsed GMAW waveforms. By carefully controlling these variables in the development of waveforms, the engineers at Lincoln Electric® can vary the welding behavior and optimize the output for an optimum weld. With these fine tuning adjustments the aluminum waveforms have been modified to drastically reduce very fine spatter that is often characteristic of aluminum spray GMAW. In addition, the nominal arc length was made more robust to prevent dark, sooty welds.

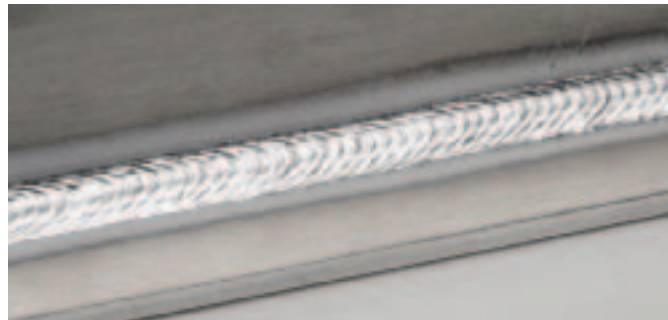


Aluminum Tug Boat Fabrication

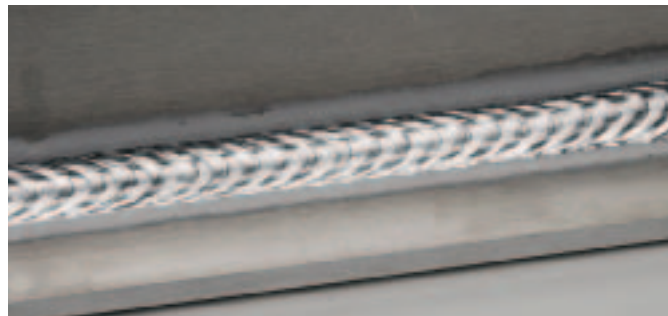
Softer Pulse and Pulse-On-Pulse® Waveforms

All Pulse and Pulse-on-Pulse® aluminum waveforms have been modified to make them softer. A crisp waveform is one where the peak current is high, the background current is low, and the rate of current rise and fall is fast. This type of waveform sounds harsh and tends to produce very fine spatter. All TOTAL s2f™ programs feature a soft waveform, where the peak current and background currents are closer to each other and the current rise and fall rates are lower. The waveform is more rounded, which yields better cleaning, eliminates spatter, provides a better bead appearance, and gives a more pleasing arc sound.

Improved Bead Appearance with Pulse and Pulse-On-Pulse® Waveforms Offer the Ability to Widen the Modulation Frequency Range to Space Out the Ripples



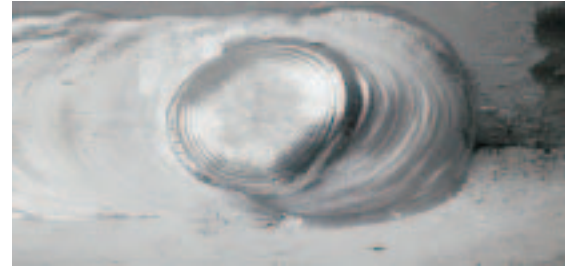
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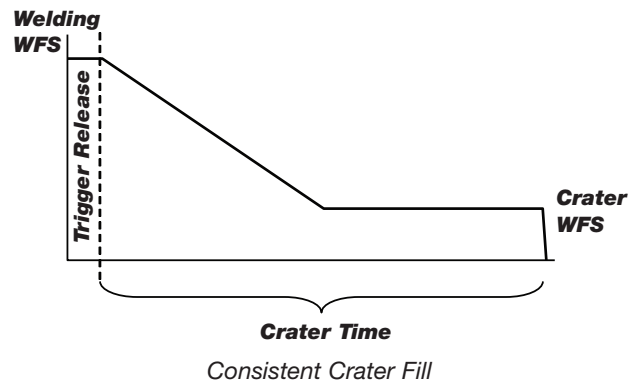
Modulation Frequency -10

New Crater Fill Procedure

The Power Wave® and Power MIG® power supplies both offer a crater fill function. The crater fill function works similar to the start function, but in reverse. Therefore, the starting WFS and trim would ramp down from the welding WFS and trim over a preset time after the operator releases the gun trigger. Now with the TOTAL s2f™ welding process, the crater fill function consists of two steps. The WFS and trim will ramp down to a selected point for half the time set for crater fill and then will stay at those values for the remaining portion of the weld, called the cap. This gives an enhanced and more consistent crater fill than with previous methods and creates a button of weld metal.



Crater Fill



Synchronized End Pulse

The key to good GMAW starting is that the end of the wire should always be the same after the arc is extinguished. There should not be a large ball on the wire end. Some operators accomplish this by cutting the wire off after each weld, but this is very costly and inefficient. Traditionally in pulse welding, the condition of the wire end varied considerably from weld to weld. This was because the condition of the wire end depended on the position of the power supply pulsing cycle when the operator terminated the arc. If the output of the power supply was turned off during the peak current of the waveform, the wire end condition would be considerably different than if the power supply output was turned off at background current. The result was considerable differences in the wire end condition.

Lincoln Electric® has found a solution to the problem. When the operator takes his finger off the gun trigger, the power supply will make one ending pulse and extinguish the arc at the end of the pulse. The arc is extinguished at the same point in the pulse cycle every time. This means that the wire end always has the same shape and size. The TOTAL s2f™ welding process transfers that last droplet, and then shuts off after the conditioning pulse, so the wire tip is conditioned. There is no large glob or ball at the end of the wire, just a consistently rounded end, perfect for starting. The result is great starting every time.



Aluminum Wire Ends, Same Shape and Size



*Consistently Rounded Wire End,
Perfect for Starting*

TOTAL s2f™ Semiautomatic Aluminum MIG Welding Solutions

The Perfect Equipment Solution for Every Application

TOTAL s2f™ Systems for MIG welding aluminum provide the best equipment for light and industrial aluminum welding needs.



Power MIG® 350MP
Push-Pull One-Pak®



Power Wave® 355M/
Power Feed™ 10M Ready-Pak®



Power Wave® 455M/
Power Feed™ 10M



Power Feed™ 25M

The Perfect Consumable Solution in Any Package

Super Glaze® aluminum consumables deliver consistent wire composition, smooth feeding, and a stable arc.



Super Glaze® 1 lb. & 16 lb. spools



Super Glaze® 300 lb. Box

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 customer and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric® for advice or information about their use of our products. We respond to our customers based on the best information in our possession at that time. Lincoln Electric® is not in a position to warrant or guarantee such advice, and assumes no liability, with respect to such information or advice. We expressly disclaim any warranty of any kind, including any warranty of fitness for any customer's particular purpose, with respect to such information or advice. As a matter of practical consideration, we also cannot assume any responsibility for updating or correcting any such information or advice once it has been given, nor does the provision of information or advice create, expand or alter any warranty with respect to the sale of our products.

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 requirement.

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.

WHAT IS NEXTWELD®?

NEXTWELD brings you a series of Process, Technology, Application and Success Story documents like this one. NEXTWELD explains how technologies, products, processes and applications are linked together to help businesses to achieve greater efficiency, increase performance and maintain their competitive edge.

NEXTWELD® is the future of welding, but its benefits are available to you today. Ask your Lincoln Electric® representative for more information on the benefits of NEXTWELD®.

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